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ENDOTHELIAL MYELOMA OR EWING'S SARCOMA[1]

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I HAVE chosen for the subject of my remarks Endothelioma. This group of tumors, while representing a smaller number of cases than the osteogenic group, deserves and is receiving special interest, chiefly because the majority of recoveries in bone sarcoma have fallen within it. While Howard and Crile[2] called our attention to a group of tumors which they classified as endothelioma, and reported four cases to which they added eighteen collected from the medical literature, their work, apparently, was soon forgotten. Ewing (1921-1922) was the first to point out that there is a group of tumors, originating chiefly in the shaft of the long bones, occurring mostly in children or young adults, and with very definite clinical, roentgenographic, and histologic characteristics which differ markedly from those found in osteogenic sarcoma and which entitle them to a separate classification. He further pointed out that these tumors, unlike the osteogenic sarcomas, are highly radiosensitive. The work of Ewing, therefore, had an important bearing on treatment, showing us in which cases we might safely subject the patient to conservative treatment, and in which (the osteogenic sarcomas), amputation should be performed immediately. Dr. Bradley L. Coley and I have shown that these tumors are very sensitive to the toxins of erysipelas and *Bacillus prodigiosus*.

My first experience with endothelial myeloma dates back to my first case of bone sarcoma, treated in 1890; and as this case was the direct cause of my early and continued interest in bone sarcoma, I shall take the liberty of referring briefly to it here.

Case 1. The patient, a female, aged 18 years, had bruised her hand two months previously by catching it between the backs of two Pullman chairs. A few days later pain was felt in the third metacarpal bone, and a swelling developed shortly thereafter. The pain, which was very severe, was treated as rheumatism by several physicians. She was referred to me by Dr. W. G. Schauffler. I did not know just what the condition was, but I was sure that it was not rheumatism. On the belief that it was a tumor of some sort I performed an immediate biopsy. A tumor was found which had involved the middle portion of the metacarpal bone, was fusiform in shape, somewhat laminated in structure, and without definite new bone formation. On microscopic examination it was pronounced a small round-cell sarcoma. I asked Dr. William T. Bull to see the patient with me. An immediate amputation was advised, and on the following day I amputated at the middle

[1]Read in part in the Symposium on Bone Sarcoma, Baltimore, September 15, 1930, and in part before the Southern Surgical Association, December 15, 1930.

[2]Howard, William T., Jr., and Crile, George W.: Ann. Surg., September, 1905, XLII, 358.

Fig. 1. Endothelial myeloma of femur. Clinical and X-ray diagnosis confirmed by biopsy. Note the definitely laminated structure of the tumor. Patient recovered under toxins (Coley's) alone; limb saved. Patient was still well, twelve years later.

of the forearm. In four weeks she had metastases to both breasts, and in six weeks she died of generalization of the disease.

This was one of the most malignant cases of bone tumor in my entire experience, and was a typical example of so-called acute traumatic malignancy, developing almost immediately at the site of a definite bruise or local injury.

Case 2. Reviewing my earlier series, the next case that stands out as a definite example of endothelial myeloma is one that was admitted to my service at the Memorial Hospital in February, 1902. The patient, a male, aged 19, had a tumor of very rapid development, involving two-thirds of the shaft of the femur. I advised a hip-joint amputation, but this was refused. I performed a biopsy, and the tumor was pronounced by Dr. B. H. Buxton, pathologist of the New York Cancer Hospital (now the Memorial Hospital), and Dr. E. K. Dunham, Professor of Pathology of the Bellevue Hospital Medical School, a small round-cell sarcoma. The tumor showed little or no new bone production. We had just installed our first X-ray machine at the Memorial Hospital, and I thought it would be well worth trying it out in this case. To my surprise, immediate and rapid improvement in the condition was noticed. The tumor decreased rapidly in size. Unfortunately, in about five months, a large metastatic tumor, the size of one's hand, developed in the left pectoral region. This also was treated by radiation, under which it showed marked regression. When it had shrunk to about one-half of its original size, I removed it surgically. A few weeks later the patient developed a large tumor, about the size of a child's head, in the ilium. This tumor was not treated by radiation but by Coley's toxins only. Within six weeks it had become soft and fluctuating. I made an incision, inserted a large tube, and drained out nearly a pint of broken-down tumor material. The tumor entirely disappeared by

Fig. 2. Case 3. Typical case of endothelial myeloma of femur; laminated structure. Early symptom, pain above knee. Treated for five months for rheumatism and neuritis before a roentgenographic or even a clinical examination of the femur was made. The tumor practically disappeared under toxins and radium. One year later metastasis developed in the thoracic wall, the disease became generalized, and the patient died in a short while.

Fig. 3. Case 5. Endothelioma of femur, illustrating the difficulties in diagnoses. At the time this film was made a clinical diagnosis of chronic osteomyelitis was made and confirmed by an extensive exploratory operation and microscopic examination of tissue removed.

sloughing and absorption, the patient regained his usual health, and remained well for ten years, when he developed an entirely different malignant tumor at the site of an old X-ray burn on the thigh, which had followed over-radiation in 1902. This tumor developed very rapidly, became foul and fungating, and I did an amputation, more as a palliative measure than anything else. Pulmonary metastases developed and the patient died a few months later. The tumor of the amputated thigh and femur showed three different histologic types: (1) large round-cell sarcoma; (2) carcinoma of the soft parts, and (3) typical epithelioma with pearls (found in the medullary cavity of the femur). No type simulated that of the original tumors. The diagnosis was confirmed by Dr. James Ewing, Dr. W. W. Welch, and Dr. W. C. Clark.

This case is of special interest inasmuch as it is, I believe, the first endothelial myeloma that was treated by primary radiation during the operable stage. It showed not only the clinical and histologic characteristics of Ewing's sarcoma, but it proved to be highly radiosensitive, and still more susceptible to the toxins. It is one of the few cases on record of the disappearance of a highly malignant bone sarcoma, with extensive metastases, under any method of treatment, the patient remaining well for ten years.

While I wish to devote most of my time

Fig. 4. Same case as shown in Figure 3. This film was made three months later, when, after further clinical and roentgenographic examination and a review of the microscopic sections, a diagnosis of endothelioma was made.

Fig. 5. Another film of Case 5, made shortly before death.

to a review of the treatment of endothelial myeloma and of the results obtained, I must refer briefly to the diagnosis, inasmuch as the method of treatment can be determined only after a correct diagnosis has been made. There is no type of bone sarcoma beset with greater difficulties in the diagnosis than the endothelial myeloma.

The most important points in the diagnosis are:

(1) *The locality of the tumor*—usually the shaft of a long bone.

(2) *History of antecedent local trauma*—in about 50 per cent.

(3) *Rapid development.*

(4) *Early pain.* This is present in the great majority of cases, worse at night, increasing in severity, and not always referable to the site of the tumor but to a region some considerable distance distally from the tumor.

(5) *Age of patient*—usually childhood or youth; rarely after the age of thirty years.

(6) *Consistence of tumor*—softer than the osteogenic sarcoma.

(7) *Involvement of a considerable portion of the shaft of the bone*—rarely including the epiphysis.

(8) *Metastases to neighboring glands or other bones*—often in comparatively early stages of the disease.

(9) *Local heat and not infrequently a moderate general temperature*—in rare cases this may rise to from 103 to 104 degrees.

(10) *Pathologic fracture in later stages of the disease.*

Referring to the age of onset, as mentioned above (see No. 5), the following tabulation is of interest:

Age	*Cases*
Under 5 years	8
From 5 to 10 years	17
From 10 to 15 years	6
From 15 to 20 years	17
From 20 to 25 years	10
From 25 to 30 years	6
From 30 to 35 years	7
From 35 to 40 years	4
From 40 to 45 years	4
From 45 to 50 years	2
From 50 to 55 years	4
From 55 to 60 years	2
From 60 to 65 years	0
From 65 to 70 years	3

In this group, 11 per cent were under five years of age, 27 per cent were under ten years, 53 per cent were under twenty years, and 9 or 10 per cent were over fifty years of age.

Most of the mistakes in diagnosis can be traced to failure to obtain a careful clinical history or, what is even more important, a careful physical examination. In a few cases, failure may be attributed to lack of roentgenographic examination: the latter is of great diagnostic value. The characteristic appearance presented by the roentgenogram is that of a destructive process of the shaft of the bone involving all the layers, resulting in a general widening or thickening of the shaft, with little or no new bone formation. The bone often has a moth-eaten appearance.

To illustrate some of the difficulties associated with an early diagnosis, I would cite the following two cases.

Case 3. H. P., a male, aged 18 years, in the early part of 1928 noticed a dull, aching pain in the region of the left knee, which was more severe at night. A diagnosis of rheumatism was made and the condition was treated as such. No improvement being noticed, the patient, three or four weeks later, consulted a prominent orthopedic surgeon, who made a diagnosis of neuritis. The pain continued and became more severe in spite of treatment, and in the latter part of September, 1928, the patient was brought to the Hospital for Ruptured and Crippled, where a diagnosis of toxic pain in the knee was made, and the patient was advised to have his teeth and tonsils examined. Two weeks later, in Hartford, a roentgenogram was taken for the first time. This disclosed a very extensive sarcoma of the middle and

Fig. 6. Case 5, showing metastases to the skull and jaw.

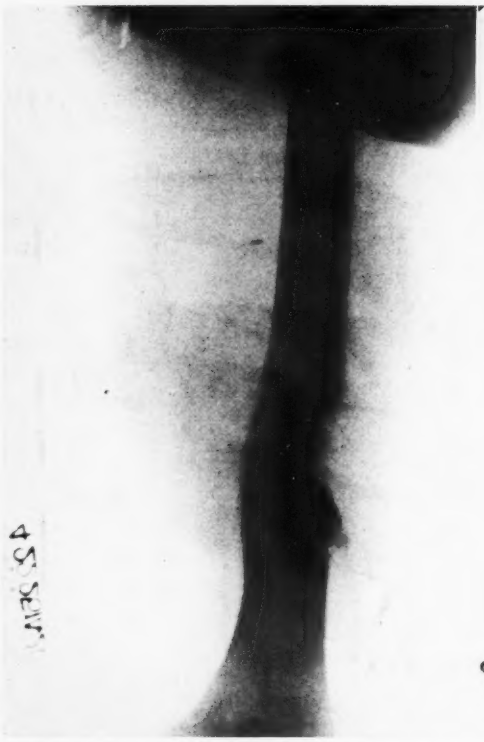

Fig. 7. Case 6. Endothelioma of femur, the roentgenographic and clinical picture of which closely resembled that of osteomyelitis. Macroscopic and microscopic diagnosis of osteomyelitis was made on biopsy. Instead, it proved to be a highly malignant endothelial myeloma. Amputation was followed by toxins; general metastasis; death one year after amputation.

Fig. 8. Same case as shown in Figure 7, this film having been made just prior to amputation.

upper third of the left femur, undoubtedly of the endothelioma type.

The patient was referred to me on October 20, 1928. He was admitted to the Hospital for Ruptured and Crippled, and physical examination at this time showed slight atrophy of the left thigh on inspection—no visible tumor. On palpation, an enlargement, firm in consistence, could easily be made out in the middle and upper portions of the left femur. The patient had lost about twelve pounds in weight. He was started on treatment with the mixed toxins in conjunction with radiation. On October 25 and 26, he had X-ray treatments, and from November 1 to December 2 he received a total of 46,000 mc.-hrs. of radium. By December 8, 1928, he had regained his lost weight, and examination showed marked diminution in the size of the tumor. He returned home, where the toxins were continued two or three times a week. About three months later he developed severe pain in the cervical region and back. A few weeks later, definite tumors could be made out by roentgen-ray examination and palpation. In spite of further treatments with toxins and radiation he died on June 28, 1929, with metastases to the skull, neck, spine, and lungs.

In this case, I believe that, had a roentgenogram been made in the early stages of the disease and the diagnosis established

four or five months earlier, the result might have been different.

A second case illustrating the difficulties in diagnosis follows.

Case 4. W. C., a male, aged 14 years, was well until the beginning of 1928, when he sprained his right ankle. No ill results followed until the latter part of July, when, while camping, he was bitten by a mosquito on the same ankle. Pain and swelling were noticed on the following day. He was admitted to the Hospital for Ruptured and Crippled on August 9, 1928. Physical examination at this time showed the patient to be in fair condition, walking with crutches. The lower portion of the right tibia was moderately enlarged, thickened, and somewhat tender. There was no fluctuation, but some increased local heat.

Roentgenographic examination showed a low-grade osteomyelitis of the lower end of the tibia above the epiphyseal line. The treatment given was incision and drainage of the right tibia.

Three weeks later the plaster cast was removed. There was considerable bleeding and oozing, and the wound was redressed. The patient was readmitted to the Hospital for Ruptured and Crippled on September 11, 1928, and was given a transfusion of 500 c.c. of blood. Roentgen-ray examination on September 14, 1928, showed no evidence of increased bone involvement. Three days later, on dressing the wound, it was found to be covered with a grayish exudate, flecked with what appeared to be a blood clot, strongly suggestive of malignancy. The clot was cleaned out, whereupon severe hemorrhage followed which had to be controlled with a tourniquet. The removed tissue was sent to the laboratory for microscopic examination, being pronounced endothelial myeloma.

I first saw the patient on September 22, 1928, and after making a thorough physical and roentgenographic examination, as well as reviewing the microscopic sections, I advised an immediate amputation, to be followed by toxin and radium treatment. The patient's father, who was a physician, would not consent to the amputation. Another transfusion was given, and on September 28 the radium pack was applied. In addition, he was put upon the toxins of erysipelas and *Bacillus prodigiosus*.

Roentgen-ray examination on October 12, 1928, consisted of two views of the right leg, showing extensive destruction of the tibia from the lower epiphyseal line upward for about three inches, with some irregular bone production and a large partially calcified mass in the soft tissues, especially on the posterior aspect. There was periosteal elevation at the upper limit of destruction, with what seemed to be a slight periosteal elevation of the fibula at the same level. The area of bone destruction appeared too sharply localized in proportion to the amount of destruction to suggest an infection; a malignant newgrowth seemed more probable. A film of the chest, made with a portable machine, showed no shadows suggesting metastases or other abnormalities. A Dakin tube was inserted in the soft tissue mass. Two weeks later the patient developed metastasis in the upper jaw; he went down-hill rapidly, and died within a few weeks.

In this case, valuable time was lost by the fact that the first specimen removed at biopsy failed to reach the pathological laboratory. After two or three weeks' persistent hemorrhage and a fungating wound, the presence of malignancy was suspected, and another specimen showed the condition to be, microscopically, an endothelial myeloma. By this time the patient had lost so much blood that his hemoglobin was down to about 50, and he was running a temperature of from 103 to 104 degrees.

This case is an example of the most malignant type of endothelial myeloma. The

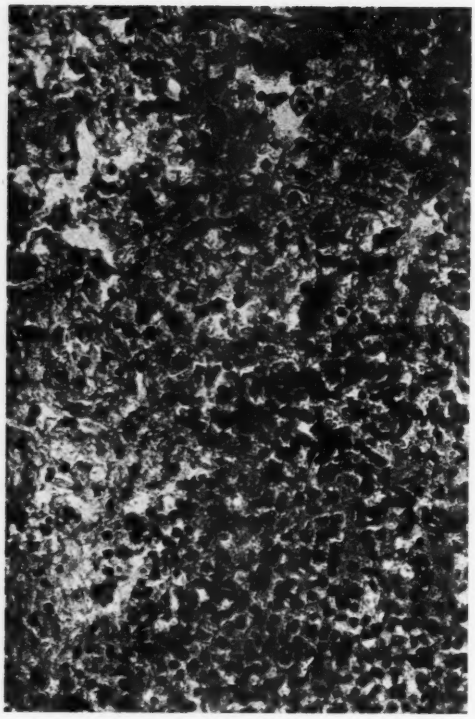

Fig. 9. Photomicrograph of tissue of Case 6.

whole course of the disease, from the time the tumor was first noticed until the patient died, was scarcely more than four months.

OSTEOMYELITIS

We find the greatest difficulty in making a differential diagnosis between endothelial myeloma and osteomyelitis. In certain cases it is impossible to make a positive diagnosis, even with all the aids at our command, including a biopsy and microscopic examination by experienced pathologists. Fortunately these cases are very rare; in the great majority we are able to make a diagnosis by carefully observing the following important points of difference.

First, we must distinguish the endothelial myeloma from a benign tumor. This is easily done if we remember that a benign bone tumor is more sharply localized; is limited usually to a single portion of a bone (either the periosteum, the cortex, or the medulla, but seldom involving all these); is of long duration; is almost always painless; never involves the soft tissues in its vicinity; never metastasizes to glands or viscera; may be bone-forming (as an osteoma or a chondroma) or may be bone-destroying (as a benign cyst or a benign giant-cell tumor).

If we include the benign giant-cell tumor, or giant-cell sarcoma as classed by some, we may find great expansion of bone, with extensive bone destruction, the cortical layer finally becoming so thin that it gives the so-called "egg-shell crackling" feeling on pressure; or it may be completely destroyed and the tumor surrounded by soft parts. Unlike the osteogenic sarcoma, it never causes a true infiltration of soft tissues. If the benign tumor is in the shaft of a long bone, it never produces the periosteal stripping so commonly seen in osteogenic sarcoma. On account of the slow growth, it may need no treatment or no surgical removal unless it interferes with the function of the limb.

Malignant giant-cell tumor is dealt with elsewhere.

In cases in which it is impossible to distinguish between endothelial myeloma and osteomyelitis, it is well to treat the condition as one of endothelial myeloma and await the subsequent clinical progress to solve the problem of final diagnosis.

Case 5. *Sarcoma of the femur, endothelioma type.* The original diagnosis of osteomyelitis was based upon clinical, roentgenologic, macroscopic, and microscopic evidence.—The patient, P. T., a male, aged 14 years, was admitted to the Hospital for Ruptured and Crippled, service of Dr. Royal Whitman, on December 7, 1922, with the following history: Three months previously the patient began to limp and complained of pain in the region of the left hip. He became very restless at night; lost ten pounds in weight. There was no fever. Physical

examination at the time of his admission to the hospital showed the left leg to be held flexed at an angle of 160 degrees—it could be abducted at 15 degrees, and very slightly rotated outward. Flexion and extension were almost entirely restricted; internal and external rotation were somewhat restricted, and there was very marked tenderness to pressure over the great trochanter. A roentgen-ray examination was made at this time, and the report was as follows: "There is a general periosteal thickening of the upper extremity of the femur which apparently extends to a point four inches below the trochanter minor, involving the periosteum and extending up to the neck, but apparently not involving the neck of bone. The interior of shaft shows changes indicative of disease."

A Wassermann test was made and proved negative.

On December 11, 1922, the patient was operated upon by Dr. Whitman. A long incision was made down over the trochanter, through the muscles to the bone. Periosteal tissue and pus were at once encountered. The tissues were separated from the bone, and the external layer of the cortex was removed for a distance of about three inches. But one-third of the bone seemed to be involved, and nothing was found in the interior—the bone became solid. According to Dr. Whitman, the condition was evidently a periostitis and not an osteomyelitis except as a secondary condition. He stated that the tissues through which he cut were more or less laminated, simulating the different layers of an onion.

Pathological report by Dr. F. M. Jeffries was: "Extensive and intensive acute osteitis; etiology does not appear."

The wound was kept open and dressed with Dakin's solution and the patient was discharged on January 11, 1923. On February 7, 1923, he returned to the Hospital for Ruptured and Crippled for examination.

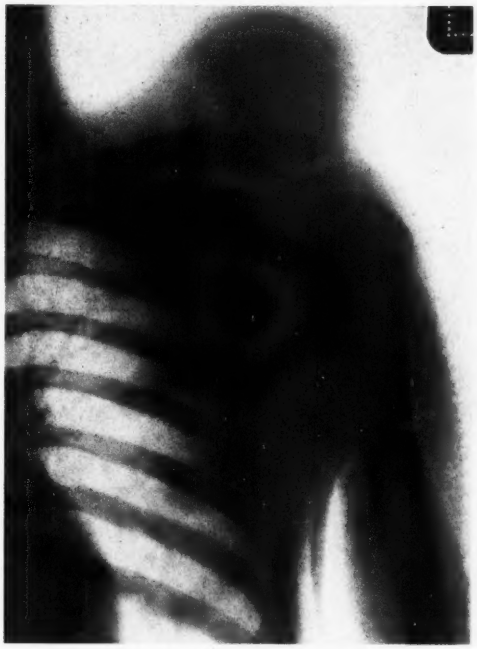

Fig. 10. Case 8. Endothelioma of clavicle in a child of 11 years, which developed rapidly immediately after a fall. Excision of the clavicle was followed by toxins and radiation. Rapid recurrence, not controlled by further treatment. Death occurred nine months from date of injury.

During the intervening month, a very great change had taken place in the thigh; it had increased in circumference to twenty-four inches. The veins were markedly dilated and distended. The swelling was firm in consistence, but not of bony hardness. Several of the inguinal glands were enlarged. At this time the clinical evidence of a rapidly growing inoperable sarcoma was beyond question. The patient was referred to me for treatment and was transferred to my service at the Memorial Hospital. Roentgen-ray examination at this time (February, 1923) showed that a very great change had taken place since the last examination was made. There was now a good deal of destruction of bone, without much new bone formation. Clinical and roentgenologic diagnosis was that of sar-

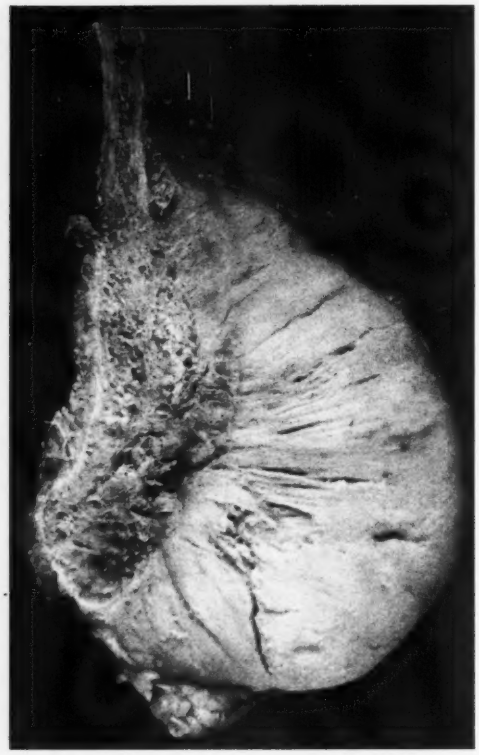

Fig. 11. Specimen removed, Case 8.

coma of the endothelioma type. The original microscopic sections were examined by Dr. Ewing, who pronounced them a sarcoma of the endothelioma type.

During his stay at the Memorial Hospital, the patient received treatment with the radium pack (50,000 mc.-hrs.), which was applied at a distance of ten centimeters over three different areas of the femur within a period of four days, and, in addition, he received systemic injections of the mixed toxins of erysipelas and *Bacillus prodigiosus*. During the following three weeks the tumor decreased very markedly in size, the circumference of the femur at the end of this time being fourteen inches. Roentgen-ray examination also showed marked changes to have taken place. The patient's general health improved. However, in April, 1923, he showed evidence of metastases in the skull, jaw, and other regions of the body, and, in spite of further treatment, he died in June, 1923.

Case 6. *Endothelial myeloma of femur.*—The patient, A. M., a male, aged 30 years, was admitted to the New York Broad Street Hospital in August, 1924, where a clinical and roentgenologic diagnosis of osteomyelitis was made. An exploratory operation was performed, and the diagnosis confirmed by microscopic examination.

On January 23, 1925, he was admitted to the orthopedic division of the Hospital for Ruptured and Crippled. An exploratory operation was performed, and a microscopic diagnosis of chronic osteitis with no evidence of neoplasm made.

The patient had had little pain and no rise of temperature, but on April 18, 1925, he returned to the hospital complaining of pain. Upon examination, there was revealed a fluctuating swelling beneath the old incision. A third exploration was performed, which was followed by considerable hemorrhage. The pain seemed somewhat less severe.

On June 20, 1925, the patient was readmitted, complaining of intense pain. There was marked swelling about the incision, semifluctuant but not tender. There was a hard gland in the inguinal region measuring about three-fourths by one-half inch. His general appearance was cachectic. Roentgen-ray examination three weeks later showed that proliferative bony changes had taken place. There was also a very definite lifting and proliferation of the periosteum, particularly from the portion of the femur below the site of the disease.

I first saw the patient in consultation on July 17, and made a diagnosis of sarcoma. I urged an immediate amputation, but to this the patient would not consent. An exploratory operation was performed by Dr. Bradley L. Coley on July 21, and the specimen was submitted to Dr. Ewing, who reported

it to be a malignant tumor of the bone marrow, probably an endothelial myeloma. A pathologic fracture occurred later. In view of the large size and the rapid growth of the tumor, an immediate amputation was again urged, and was performed by Dr. Bradley L. Coley on July 31. Prophylactic toxin treatment was given for a considerable period. The patient remained in excellent health for over a year and regained over fifty pounds of lost weight. He was readmitted to the Memorial Hospital on January 1, 1928, at which time roentgen-ray examination showed a group of metastases in each lung. He was then given intravenous injections of toxins and a cycle of roentgen therapy. The disease reached a stage where the patient refused all further treatment, and its steady progress caused death in August, 1928.

Case 7. *Osteogenic sarcoma of the femur closely simulating osteomyelitis.*—I. L., a male, aged 20 years, in March, 1921, caught his left leg in the door of a subway train, and his thigh was severely squeezed. Nothing unusual was noticed until three days later, when he felt severe pain in the injured thigh just below the great trochanter. This was intermittent at first, keeping him in bed for a few days at a time, but later the attacks became more frequent. A swelling was noticed, which gradually increased in size. The patient was admitted to the Jewish Hospital of Brooklyn on July 25, 1923, where an operation (osteotomy and curetting of bone) was performed on August 7, 1923. A microscopic examination was made, and the report was as follows: "Specimen consists of degenerated soft tissue in which there are embedded small pieces of sclerotic bone tissue. *Microscopic diagnosis:* osteomyelitis of left femur." A section of this specimen was examined by Dr. F. M. Jeffries, whose diagnosis was that of productive osteitis. Dr. Ewing, who also examined a section, concurred in the diagnosis and said that one edge of the specimen showed a slight suspicion of possible neoplasm, but not enough upon which to make a diagnosis. Roentgen-ray examination made in 1923 showed nothing at all suggestive of sarcoma. There was a marked thickening of the femur, with sclerosing of the bone, typical of a chronic sclerosing osteitis. Physiotherapy treatment was begun in the latter part of 1924.

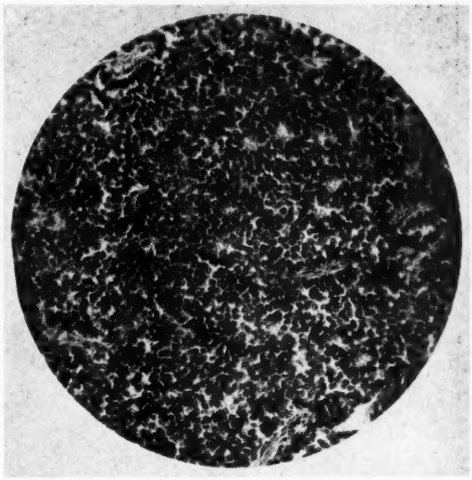

Fig. 12. Photomicrograph of tissue removed from Case 8.

On March 13, 1925, the patient was admitted to the Hospital for Ruptured and Crippled. A roentgenogram taken at this time showed that certain changes had occurred since the last film was made: the bone was larger and thicker than it was at that time; the density seemed not quite so marked; instead of the periosteal line of the bone being intact, there were a few erosions in one area—a few indentations in the normal outline; apparently there was a small amount of new bone production beyond this normal line. The film, however, did not permit one to make a diagnosis of sarcoma, although it was more suggestive of sarcoma than the earlier ones. A few months later, no improvement in the condition having

Fig. 13. Case 9, patient of Dr. S. L. Christian and Dr. L. A. Palmer. Tumor of tibia, of bone marrow origin, classified as endothelial myeloma or multiple myeloma. Amputation in September, 1925, was followed by extensive generalization of the disease to the bones and soft parts, and loss of weight (December, 1925). Under toxins alone, the patient made a complete recovery, and was in excellent condition in March, 1931, five years after treatment was begun.

been noted, the patient was admitted to Dr. Royal Whitman's service (Hospital for Ruptured and Crippled) and I was asked to see him. The clinical appearance of the tumor, as well as the roentgen-ray evidence, in my opinion, was strongly suggestive of a neoplasm rather than an osteomyelitis. An exploratory operation was performed by Dr. Whitman on March 16, 1925, revealing soft, vascular tumor tissue which had broken through the muscle. This was examined microscopically by Dr. Jeffries, and pronounced a mixed-cell sarcoma. Dr. Ewing also examined a section, and he reported as follows: "Osteogenic sarcoma, polygonal cell, malignant." Amputation was advised and refused.

The toxin treatment was begun on April 1, 1925, and continued in gradually increasing doses for two months. At the end of six weeks' treatment, the circumference of the thigh had diminished two inches, and the patient's general condition had shown marked improvement. Low voltage roentgen-ray treatment was begun at the Memorial Hospital by Dr. Ralph E. Herendeen. From May 7, 1925, until November 13, 1925, the patient received seven exposures of sixty minutes each.

The patient remained well for about one year and then began to have vague pains in different parts of the body, especially in the affected femur. Roentgen-ray examination was negative. Later on, however, he developed evidence of metastases in the lungs, retroperitoneal glands, and various other parts of the body. In spite of further treatment (toxins and radiation), the condition gradually grew worse and he died a few months later.

OSTEOGENIC SARCOMA

The next step—and a very important one—in diagnosis is to differentiate the endothelial myeloma from the osteogenic sarcoma. This must be done at a comparatively early stage of the disease if we are going to give the patient that very fair chance of saving his life. Here, fortunately, it is possible to make a correct differential diagnosis in most cases by paying due heed to the following clinical and roentgenologic features.

Osteogenic sarcoma usually occurs at a slightly older age than does endothelioma. It has almost the same history of antecedent local trauma, *i.e.*, about 50 per cent, and pain is also the first symptom. As in endothelial myeloma, the pain may be a referred one, not occurring at the site of the tumor. This has led to many errors in diagnosis, the surgeon confining his examination to the locality of the pain and not examining or taking roentgenograms of the bone or bones higher up (see Case 3).

Unlike endothelial myeloma, osteogenic sarcoma usually begins at the extremity of a long bone, in the diaphysis, and seldom involves the epiphysis until the later stages of the disease have been reached. While it apparently begins in the periosteum or subperiosteum in the vast majority of cases, giving rise to the older classification of periosteal sarcoma which was adopted in all countries until recent years, it usually involves the central portion of the bone simultaneously or very quickly, without, however, destroying the layer of the cortex. The shape of the tumor is more or less characteristic. It is apt to be pear-shaped, the larger part corresponding to the end of the long bone and tapering off towards the middle of the shaft. There is often an elevation or a lifting of the periosteum along the shaft at the line of the advancing tumor. This is quite characteristic of osteogenic sarcoma.

The tumor itself is fairly smooth on palpation. Its consistency may give important information: it is not so hard as the chondroma or osteoma, nor so soft as the endothelial myeloma that has destroyed the cortex of the bone. There is a certain amount of resilience on palpation. The consistency may vary with the type of osteogenic sarcoma, being harder in the chondrosarcoma or the sclerosing ossifying sarcoma than in the more cellular types.

The rapidity of growth which enables one to differentiate an osteogenic sarcoma from a benign tumor is of little help in distinguishing the former from an endothelial myeloma. While most writers have stated that osteogenic sarcoma is more rapid in growth than endothelial myeloma, and more quickly fatal, I hold a different opinion. These writers have based their statistics upon the duration of life in the 54 cases of the Bone Sarcoma Registry reported by Connor, without referring to the very natural explanation that increased duration of life in the cases that lived beyond one or two years was, in practically every instance, due to treatment with radiation or toxins. If we confine our examination to the older cases of sarcoma of the shaft of the bone, generally classed as round-cell sarcoma (prior to Ewing's publication of 1921), we find that this group was the most malignant of all types of malignant bone tumor.

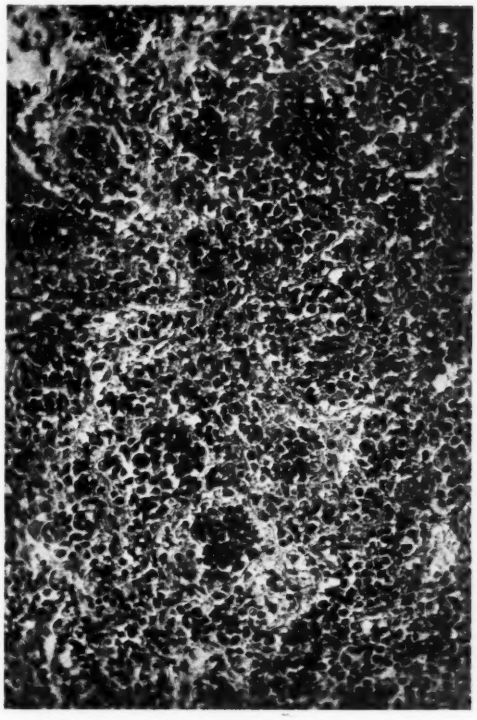

Fig. 14. Photomicrograph of tissue, Case 9.

Fig. 15. Case 10. Spiral fracture of the shaft of the humerus (May, 1923), showing no evidence of a pathologic condition at the time of injury.

That we have found the means to control this type of tumor (endothelioma) by a selected method of treatment, in a larger proportion of cases than it has been found possible to do in osteogenic sarcoma is most fortunate; but it should not let us fall into the error of regarding the endothelial group as a more benign form of bone sarcoma. I have seen an osteogenic sarcoma of the femur, in a boy aged 11, cause death in four months from the date of the trauma (kick) which was the apparent causative factor in the development of the tumor; and I have seen an endothelial myeloma of the humerus, in a boy aged 5, cause death in four months, in spite of heavy treatment. Obviously, the duration of the tumor gives us little information in differentiating the endothelial myeloma from the osteogenic sarcoma.

Case 8. *Endothelial myeloma of clavicle.*—A. P., a female, aged 11 years; family history negative. In the middle of February, 1924, the patient fell, striking on her left shoulder. A swelling appeared promptly which increased rapidly in size, until, two weeks later, when, having attained huge proportions, it remained stationary for a week. There was no pain and only slight limitation of motion.

The patient was referred to me on May 7, 1924, and was admitted to the Memorial Hospital. Physical examination at this time showed, at the top of the left shoulder, a globular swelling about three inches in diameter—or about the size of a small orange—markedly protuberant, and, apparently, originating in the outer half of the clavicle. The tumor was smooth in outline, soft, semi-fluctuating in consistence at the upper portion but firmer at the base. The skin was dark, almost purplish in color, over the upper portion, and stretched thin by the rapid growth of the tumor. The veins were dilated.

X-ray report, May 12, 1924: Stereoscopic plates of the chest revealed the presence of a destructive process involving the outer third of the left clavicle. The process extended in the medullary cavity into the middle third of the shaft of the clavicle; it was irregular in character and not limited or encapsulated. Very little bone production was seen; considerable of the cortex in the superior surface had been destroyed. The outline of a soft-part tumor above was noted. There was no evidence of metastasis to the lungs.

I excised the clavicle on May 14, 1924.

Pathological report (Dr. Ewing), May 14, 1924: The tumor involved 6 cm. of the clavicle, and 4 cm. of the shaft was largely destroyed by tumor tissue which had invaded the marrow cavity and dissolved most of the bony tissue. The tumor formed a globular mass 5 cm. high. It was well

circumscribed and pushed the skin before it. The tumor tissue was very soft—in places diffluent, elsewhere soft and opaque. Grossly it was a medullary and subperiosteal osteogenic sarcoma.

The tumor was composed of a very rich growth of small rounded or polyhedral cells, consisting almost wholly of hyperchromatic nuclei. They grew diffusely, or were arranged about small blood vessels, or inclosed spaces in which there was blood or other fluid. There was no bone production anywhere, and no osteoid tissue. There was no stroma between the cells. The appearance was that of a very anaplastic tumor. It seemed to fall in the group of endothelial myeloma.

Immediately after the operation, bare tubes of radium (8 millicuries) were buried in the wound. There was some sloughing at this point. Two weeks later the toxin treatment was begun and kept up until August, 1924, after the patient had returned home. Early in August a local recurrence took place. A massive dose of radium was applied. In spite of this and continued toxins, the disease progressed steadily and caused death on November 28, 1924, nine months after the injury.

THE ROENTGENOGRAM

The roentgenogram is often of the greatest help, and, in many cases, it, in conjunction with the clinical history and physical signs, enables one to distinguish both the endothelial myeloma and the osteogenic type of sarcoma.

If we are dealing with an endothelioma, the roentgenogram will show a tumor of the mid-shaft, osteolytic in type, whose destructive process has involved all the layers of bone. The tumor replacing the destroyed bone often presents a laminated structure, with little or no new bone formation. If, however, we are dealing with an osteogenic sarcoma, the roentgenogram will usually show a tumor of the end of a long bone made up largely of new bone, or new bone and cartilage, superimposed upon the cortex, without expansion of the cortex, and infiltrating more or less the adjacent soft parts. The roentgenogram will commonly show an involvement of the medullary portion, but the actual involvement of the medulla is much greater than is apparent, as has been proved by subsequent amputation. The new bone is frequently arranged in spicules, at right-angles to the axis of the long bone. This does not occur in all cases, as one might be led to believe from most text-books, but in less than one-fourth of the cases, according to Kolodny's study of the Bone Sarcoma Registry cases. From my personal experience I should say that I have observed it in less than one-third of the cases. When it does occur it may be regarded as almost pathognomonic of osteogenic sarcoma, although in certain very rare cases of osteomyelitis this type of new bone formation has been found.

BIOPSY

In a number of cases, in order to make a positive diagnosis, a biopsy and microscopic examination will be necessary. While some writers, notably Ewing, are opposed to biopsy in endothelial myeloma, I believe it should always be performed in the small group in which one is otherwise unable to make a correct diagnosis. The importance of knowing the nature of the tumor before prescribing the type of treatment to be employed far outweighs the so-called disadvantages of a biopsy. My opinion is that these disadvantages are more theoretical than practical.

The biopsy should not be performed as a routine measure in all or in almost all bone tumors, but should be reserved for cases in which there is a reasonable doubt

Fig. 16. Same case as shown in Figure 15, this film having been made one year later, showing a very extensive endothelial myeloma of the humerus at the site of the fracture. The condition was inoperable at the time of the author's first observation. The case was treated with toxins for two and a half years in addition to two radium pack treatments. Good recovery was made, the patient being well six and a half years later, with a useful arm.

Fig. 17. Same case as shown in Figures 15 and 16, this film having been made fourteen months after treatment was begun. The fracture united without immobilization of any kind, the entire period of disability being three months.

after all the other aids to diagnosis have been employed. It should be performed only by the surgeon who is to have the subsequent care of the patient, and who is prepared to carry out the best method of treatment as determined by the biopsy; namely, if the biopsy shows the condition to be one of endothelial myeloma, then the patient should be given conservative treatment with Coley's toxins and radiation. This offers a fair hope of saving the limb as well as the life of the patient. Only after failure to control the disease by conservative treatment should amputation be performed.

On the other hand, if the biopsy reveals an osteogenic sarcoma, especially with considerable new bone formation, we know that we are dealing with a tumor which is highly resistant to both toxins and radiation, and that there is almost no hope of saving the limb by conservative treatment. Furthermore, we know from long and larger experience that preliminary radiation in such cases does not improve the prognosis of the later amputation, which will almost certainly be necessary in a few months. For this reason we should be prepared to do an immediate amputation if the biopsy shows the tumor to be an osteogenic sarcoma. Dean Lewis advocates making the diagnosis from a frozen section at the time of biopsy, and, if the diagnosis is positive, to proceed at once with the amputation while the tourniquet is still on, thereby lessening the chances of metastases from tumor cells getting into the circulation at the time of the operation. While I have employed this method in a

few cases, I believe that there are not a few instances in which it is impossible to make a positive diagnosis from the frozen sections alone, and that one must wait for decalcification of the bone and for the paraffin sections. I think there is very little actual risk from this delay. In a number of cases, with a typical clinical history, the macroscopic appearance of the tumor, as disclosed at biopsy, has been so characteristic that I have been willing to amputate without waiting for sections.

During the last year we have used the aspiration method of diagnosis in a considerable number of bone tumors. While it has not proven of great value in the osteogenic type with much new bone formation, it has proved very useful in the endothelial myeloma type, making a biopsy unnecessary in a large proportion of cases.

TREATMENT

Having made a correct diagnosis, the important question arises: What method of treatment should be advised? Surgery alone has given very poor results: only one case in 22 reported by Howard and Crile was alive three years after amputation. I have never seen a case cured by amputation alone, but, then, I have not had a large experience with this method, having adopted prophylactic toxin treatment after amputation as a routine measure many years ago.

A review of the literature does not help us reach a definite decision. Connor's[3] series of 54 endotheliomas collected by the Bone Sarcoma Registry (up to 1926) shows only four patients alive and well five years after treatment. Various methods were employed. One myeloma of the os calcis was treated by amputation alone by Dr. J. E. Thompson, of Galveston, the patient remaining well for eight years. The other three five-year recoveries were my own cases. All were treated with toxins plus surgery. One had amputation and prolonged post-operative toxin treatment. One with metastasis to the glands of the groin before amputation, had post-operative toxins for three months, and one application of the radium pack over the large tumor (size of a child's head) in the iliac fossa. This patient, furthermore, according to Dr. Herendeen's report, had pulmonary metastasis. He is now well, ten and one-half years later. The third case, an even more remarkable one, is a boy, aged 3½ years, upon whom Dr. Stuart McGuire, of Richmond, Va., had performed a hip joint amputation for a periosteal sarcoma of the femur one and one-half years before (in 1917). The original diagnosis was round-cell sarcoma; that of Dr. Ewing and the Bone Sarcoma Registry was endothelial myeloma. I first saw the boy in June, 1919, at which time he had a large tumor which involved nearly all of the right parietal bone, almost completely destroying the bone. There was marked exophthalmos of the right eye, and impaired vision. A similar area of bone destruction was found in the occipital region. Although the prognosis seemed absolutely hopeless I decided to try a combination of local radiation and systemic toxins (Coley's). A lead tray (2,000 millicurie-hours of radium) was applied at 3 cm. distance over the parietal bone, and a similar dose was applied to the top of the head, to the right of the median line. In addition, the patient was put upon systemic injections of the toxins at once. After three or four weeks, marked improvement was noticed. He returned home and the toxins were given there by his family physician. I saw him again six months later and found that the improvement had been continuous. A second dose of radium was given as before, and the toxins were resumed. When the patient returned to me again, at the end of another six months, examination showed that the

[3]Connor, Charles L.: Arch. Surg., April, 1926, XII, 789.

tumor had apparently entirely disappeared, the destroyed bone had been replaced by new bone, the exophthalmos had disappeared, and he had regained his normal health. He was given another radium treatment at this time, more as a precautionary measure, and the toxins were kept up in small doses, with occasional intervals of rest until he had received them over a period of four years. He has been in excellent health ever since, now over eleven years since the treatment was first begun.

These last two cases would seem to furnish convincing evidence of the value of the toxins in endothelial myeloma even if there were no other cases on record.

The following case of Christian and Palmer is undoubtedly the most remarkable one thus far reported.

Case 9. *Endothelial myeloma or multiple myeloma, primary in the tibia. Two months after amputation multiple tumors developed in the skull, clavicle, and femur; metastases to the groin and abdominal wall.*[4]

The patient, G. B., a male, aged 31 years, a master mariner, was admitted to the U. S. Marine Hospital, Stapleton, S. I., under the care of Dr. S. L. Christian and Dr. L. A. Palmer on June 30, 1925, with a history of having injured his left tibia in February,

[4]For full report, see Christian, S. L., and Palmer, L. A.: Military Surgeon, July, 1927, LXI, 42, and Am. Jour. Surg., February, 1928, IV, 188.

DIFFERENTIAL DIAGNOSIS

Symptoms	*Endothelioma*	*Osteogenic sarcoma*	*Osteomyelitis*
1. Age of patient	Children and young adults. Lesion usually single in early stage	Young adults and middle age. Lesion single	More common in youth. Lesion multiple or single
2. Antecedent local trauma	In 50 per cent	In 50 per cent	In 33 per cent
3. Duration	Short	Short	Apt to be longest
4. Pain	Usually first symptom	First symptom	First symptom
5. Local swelling	Few weeks or months after pain	Few weeks or months after pain	More slowly developing
6. Local temperature	Rare in early stages, common in later	Few weeks or months after pain	Rare in early stages, common in later
7. General temperature	Infrequent; usually 99° to 102°, may reach 104°	Rare	Rare or low-grade
8. Location of tumor. X-ray appearance	Shaft of bone, usually more than one-half	Either end of the diaphysis of long bone, usually less than one-half	Shaft of bone, but less than one-half and more localized
9. Clinical character of tumor	Bone destruction; laminated structure	Bone-forming; new bone spicules radiating at right-angles to shaft	New bone, eburnation, sequestrum, and abscess
10. Multiple in bone	Usually	Rarely	Rarely
11. Metastases to glands	Not infrequent	Very rare	None
12. Radium—effect	Radiosensitive	Radioresistant	No response to radiation
13. Toxins (Coley's) —effect	Very sensitive to toxins	Resistant in most cases; highly cellular types may be susceptible	No response to toxins

1918. There had been recurrent attacks of pain, swelling, and tenderness in the same tibia for a number of years. The condition was regarded as osteomyelitis, and an operation had been performed on August 18, 1919. In April, 1925, a swelling was noticed a little higher up on the same tibia. A roentgenogram showed marked decalcification of the upper third of the left tibia, with only part of the skeleton of bone remaining, appearing like a bone dissolving under corrosive fluid, in the anterior upper third of the tibia. A film taken three months later showed further advance of the erosion, as well as a pathologic fracture at the junction of the upper and middle thirds of the tibia. A biopsy was performed on September 11, 1925, and the laboratory report was: "Myelosarcoma, very cellular, with slight fibrosarcomatous structure. The growth is composed of a mass of cells without regular arrangement. The cell units are small, polyhedral, with indistinct borders, often appearing as a syncytium. They are very uniform in size."

On September 21, 1925, an amputation at the middle third of the thigh was performed. The pain in the stump persisted, and two months later a nodule appeared beneath the skin just above the umbilicus. A specimen of this was examined by Dr. Ewing Taylor, who pronounced it a myelosarcoma, metastatic.

By January 5, 1928, a tumor the size of a man's fist had developed on the inner aspect of the stump, and another growth, about the size of a lemon, over the outer aspect. Also, there was a mass $2 \times 1 \times 2$ inches in the left inguinal region, and one, three-quarters of an inch in diameter, in the supra-umbilical region, involving the skin. The stump measured 19 inches in circumference.

Injections of Coley's toxins were begun in the first week of January, 1926, severe reactions following. By January 22 the circumference of the stump had diminished 1⅞ inches, the mass in the groin had disappeared, and the supra-umbilical mass was decidedly smaller and softer. The toxins were continued in doses as high as 18 minims daily. By February 20, they had to be discontinued owing to the extreme weakness of the patient. At this time the stump had taken on new growth, associated with considerable edema of both good leg and stump. On March 27, 2 minims of Coley's toxins were injected directly into the tumor mass on the stump. By April 7, the patient was receiving 5 minims into the tumor, which dose was followed by marked reaction. During May and June the patient grew steadily worse, with multiple metastases appearing in many parts of the body, including the right clavicle, scalp, cranial bones, and cervical vertebræ. The stump had reached

Fig. 18. Same case as shown in Figures 15-17, this film having been made five years after the original fracture.

a circumference of 31 inches; the end of it had broken down over an area about five inches in diameter, from which there was a foul, profuse, ichorous discharge.

On August 5, 1926, Coley's toxins were resumed and by the end of a month the dose had reached 17 minims. By this time, marked improvement was noticed both in diminution in the size of the stump and disappearance of many of the metastatic nodules. By November 22, the general condition of the patient was excellent, his weight was 147 pounds (in the beginning of the same year it was 117 pounds), the stump-wound had healed, and the nodules in the abdomen, umbilical region, scalp, and skull had entirely disappeared. At the present time (January, 1931), five years since the treatment was begun, the patient is still in excellent health, with no evidence of a recurrence of the disease.

This case (No. 1143) has been classified by the Bone Sarcoma Registry as a Ewing's sarcoma.[5]

Case 10. *Endothelioma of upper two-thirds of shaft of humerus; pathologic fracture.* Treated with toxins and radium. Patient well six and one-half years since beginning of treatment. The patient, E. M., a male, aged 47 years, was referred to me by Dr. William C. Sheehan and Dr. John B. Deaver, of Philadelphia, in July, 1924, for a tumor that had started in a fracture of the left humerus—the upper third. One year later a tumor had developed at the site of the injury. On examining the patient I found his left shoulder to be markedly enlarged over the outer and anterior aspects, the swelling occupying the whole region of the deltoid and extending up to the tip of the clavicle. It was soft in consistence, semi-fluctuating, and extended out to the pectoral muscle. Motion at the shoulder was considerably limited. The skin was normal in appearance and there were no dilated veins.

In this case the roentgenologic and clinical evidence was so clear that it was possible to make a definite diagnosis without a biopsy. In the opinion of most of the surgeons who had examined the patient, the condition was one that was beyond shoulder joint amputation. He was treated with toxins (erysipelas and *B. prodigiosus*) injected directly into the tumor, supplemented by radium pack treatments, 10,000 mc.-hrs. of radium being applied at 7 cm. distance over three different areas. Another radium pack treatment was given in December, 1924. In the first four weeks of treatment, the tumor diminished five inches in circumference, and the patient regained his lost weight. He proved highly susceptible to the toxins, a very small dose producing a temperature of 104.5°. The injections were continued until April, 1926. Prior to that, in February and March, 1925, the patient had resumed his arduous work as a landscape gardener. There was reunion of the pathologic fracture and complete restoration of function. He is still well at the present time (January, 1931), six and one-half years since the beginning of treatment.

In this case the diagnosis of the Bone Sarcoma Registry (see Case No. 596) was Ewing's tumor.

Case 11. *Endothelioma of the fibula, with extensive metastases to the femoral, inguinal, and iliac glands, and probably to the lungs.* Treated by amputation, toxins for three months, and one application of radium to the groin. Complete recovery; patient well eleven years later. The patient, H. S., a male, aged 8 years, was first seen by me in consultation with Dr. Royal Whitman, in May, 1920. Five months previously the patient had been struck on the outer side of the right leg, shortly after which pain and swelling had developed. An operation was performed by Dr. Whitman in March, 1920,

[5]This patient was presented at the New York Surgical Society meeting on March 25, 1931.

and a clinical and roentgenologic diagnosis of osteomyelitis had been made. Microscopic examination, however, showed the condition to be a periosteal sarcoma.

When I first saw the patient, the lower two-thirds of his fibula was occupied by a large tumor, apparently of periosteal origin, fungating in the central portion at the site of the recent curettage. The glands in the groin were enlarged—one was the size of an English walnut. I advised an immediate amputation, which was performed by Dr. Whitman. Both Dr. Jeffries, of the Hospital for Ruptured and Crippled, and Dr. Ewing, of the Memorial Hospital, regarded the tumor as an endothelioma.

The patient was immediately started on toxins, which were given at first daily, and then three times a week. The glands in the groin decreased somewhat in size but did not disappear. In July, a gland was removed for microscopic examination and pronounced a round-cell sarcoma (endothelioma). The toxins were continued until the middle of August, when the patient was permitted to go home on account of the excessive heat. Re-examination on October 23 showed the inguinal glands to have increased in size, and a hard mass the size of a child's head was discovered in the right iliac fossa, evidently involving the retroperitoneal glands. A roentgenogram of the chest was taken, which, Dr. Herendeen, roentgenologist of the Memorial Hospital, reported as showing unquestionable pulmonary metastases. The radium pack, consisting of 10,109 mc.-hrs. of radium, was applied at 7 cm. distance over the groin. As a hopeless prognosis had been made, no further treatment was employed.

The patient was next seen in September, 1921, when careful examination failed to reveal any evidence of a tumor in the abdomen or groin, and a roentgenogram of the chest showed no evidence of the metastases that had been present in the preceding

Fig. 19. Case 11. Sarcoma, endothelioma type, of the fibula, with extensive metastases to the inguinal and iliac glands. There was also evidence of pulmonary metastasis. Amputation was followed by toxins and one radium treatment over the iliac fossa. The patient recovered and was well in March, 1931, eleven years later.

October. The patient was in excellent health and had been attending school regularly. He is still well at the present time (January, 1931), eleven years later.

In this case the diagnosis of the Bone Sarcoma Registry (see Case No. 267) was Ewing's sarcoma.[5]

The following case is another example of an angio-endothelioma, with multiple metastases (pulmonary), which were held under control for more than five years by toxins and radiation.

Case 12. *Sarcoma, angio-endothelioma type, of tibia and fibula.* The patient, C. P., a male, aged 28 years, was admitted to the Memorial Hospital in August, 1924. One year previously he had complained of pain and swelling in the calf of the left leg. The condition was first regarded as myositis ossificans. In September, 1923, the tumor was removed and a diagnosis of alveolar

Fig. 20. Same case as shown in Figure 19.

sarcoma was made. Intensive roentgen therapy was administered. In August, 1924, the patient complained of severe pain and weakness in the upper end of the fibula, and, at the same time, a swelling was noticed in the lower end of the tibia.

Roentgen-ray examination on his admission to the Memorial Hospital showed a central tumor of the tibia that had destroyed the bone for a distance of three or four inches. A film of the chest showed distinct evidence of pulmonary metastasis. Under continued roentgen therapy, the disease was kept under fair control until the Summer of 1925, when the tumor of the tibia and the metastatic tumor of the lung began to show evidence of increase in size. The patient was readmitted to the Memorial Hospital and put upon toxins. By September 14, 1925, he had received 22 injections, in doses sufficient to produce a rise of temperature to 104 or 105 degrees, whereupon the injections were discontinued. Examination at this time showed decided improvement in the patient's condition—he had gained 18 pounds in weight, and there was evidence of some regression of the tumors of the tibia and lung.

A pathologic fracture had occurred which showed no tendency to unite, and, as the limb was entirely useless, it was thought advisable to amputate it. This was done by Dr. Bradley L. Coley on June 2, 1926. Dr. Ewing's diagnosis was angio-endothelioma, very bizarre structure.

Examination on November 23, 1926, showed the patient in very good general condition; he had gained 15 pounds in weight, and there was no evidence of any increase in the metastasis to the lung. Another course of toxin treatment was administered. He was still in good condition in November, 1929, at which time roentgen-ray examination showed no exacerbation of the disease in the lung; if anything, there was evidence of some diminution. A few days later he had an attack of coal-gas poisoning, followed by severe headaches. He went into a coma and died on January 1, 1930. No autopsy was performed, so that it is impossible to say whether death was due to the disease or to coal-gas poisoning.

In this case the diagnosis of the Bone Sarcoma Registry (see Case No. 574) was metastatic hypernephroma.

RADIATION

While it is perfectly legitimate to try conservative treatment in endothelioma of the long bones, I do not think we are any longer justified in trying to save the limb by either radiation or toxins in osteogenic sarcoma. Some fifteen years ago, when we had acquired our first large amount

of radium at the Memorial, and had installed high voltage X-ray machines, I believed we were justified, especially inasmuch as the Memorial Hospital was a research institute, in trying out these newer methods of treatment in the hope of improving the very bad prognosis which surgery alone offered in these cases. Primary radiation was employed as the method of choice in a very large number (121) of early operable cases of osteogenic sarcoma and endothelioma. We believe that a careful study of the end-results obtained in this series should furnish valuable data from which one may be able to formulate some general rules as regards future treatment.

Of the 121 cases of operable malignant tumor (osteogenic sarcoma and endothelioma, exclusive of giant-cell tumor) of the long bones treated by radiation as the primary method of choice, 62 became inoperable or developed metastases while undergoing treatment. Only one case recovered and remained well for five years. Unfortunately, in this case no microscopic examination was made. While the diagnosis made at the Hospital for Ruptured and Crippled, before the patient was transferred to the Memorial, was that of osteomyelitis, the Bone Sarcoma Registry has classified this as a case of endothelioma.

Of another group of 59 cases in which amputation had to be performed after failure to control the disease by radiation, six have remained well for a period of five years. So that, of a group of 121 cases treated primarily by radiation, we have seven (or 5.78 per cent) well for five years or more.

In spite of these exceedingly unfavorable results following primary radiation—which I am certain are not generally known to the profession—I believe that the majority of cases of osteogenic sarcoma of the long bones in the United States are being treated to-day by primary radiation as the method of choice. During the last few weeks I have had under my care a man, aged 40 years, suffering from a periosteal osteogenic sarcoma of the middle third of the femur, which had been treated for eight months at one of the largest and best hospitals in New York with radiation, after the diagnosis of osteogenic sarcoma had been established by an early biopsy. This treatment was continued in spite of the fact that the tumor was steadily growing and was accompanied by increasingly severe pain. When the patient was admitted to the Hospital for Ruptured and Crippled the tumor had reached such a size that it was beyond hip joint amputation. The biopsy wound had become a large, fungating opening extending into the depths of the tumor, discharging seropurulent material. The condition was beyond hope of benefit from any form of treatment—the patient was simply made as comfortable as possible. Shortly after his admission he began to have slight hemorrhages from the fungating wound, which, becoming more and more frequent and profuse, could not be controlled, and two weeks ago he died. Fortunately we were able to perform an autopsy. This revealed one quart of blood in the large cavities of the tumor, but no metastases in the lungs or elsewhere, so that, had an early amputation been performed at the time the diagnosis was made, in all probability the life of the patient would have been saved.

The first large single series of endotheliomas to be published was that of Dr. Bloodgood's clinic at Johns Hopkins, reported by Geschickter and Copeland,[6] a paper which is one of the best and most noteworthy ones ever written on the subject. It is based upon a careful clinical, roentgenologic, and histologic study of 60 cases observed at the Johns Hopkins Hospital, and gives the end-results obtained by various

[6] Geschickter, Charles F., and Copeland, Murray M.: Arch. Surg., February, 1930, XX, 246; March, 1930, XX, 421.

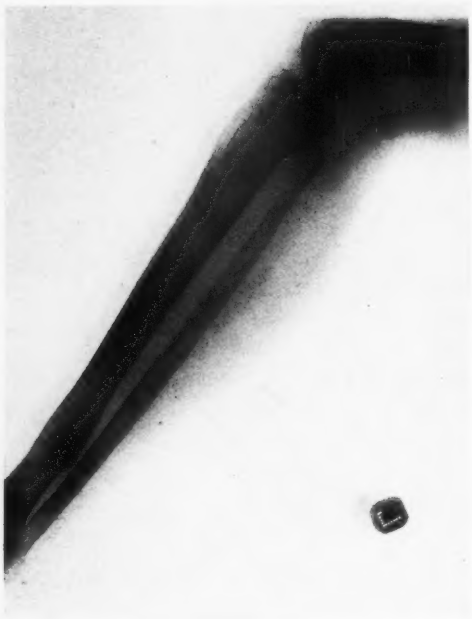

Fig. 21. Case 12. Angio-endothelioma of the tibia and fibula, with metastasis to the lungs (August, 1924). It was controlled temporarily by radiation. Toxin treatment was begun in August, 1925, followed by some improvement in condition and gain in weight. Because of non-union of the pathologic fracture and the useless condition of the limb, amputation was performed in June, 1926. Intravenous toxins were given, with occasional intervals of rest, for three years. Patient in good condition, and films of the chest made in November, 1929, failed to show any evidence of exacerbation of disease in the lungs. A few days after this examination the patient had an attack of coal-gas poisoning, followed by severe headaches. One month later he went into coma and died in a few hours. Since no autopsy was performed it is impossible to say whether death was due to disease or to coal-gas poisoning.

methods of treatment. The series is divided as follows:

Group 1: 13 cases treated by amputation or resection with irradiation; 3 well over five years.

Group 2: 24 cases treated by amputation or resection without irradiation; 4 well over six years.

Group 3: 8 cases treated by irradiation alone or with exploratory operation; none well over five years.

One case (humerus) in which Coley's toxins were used, died fourteen months later. I regret to say that the authors, in both of their reports, state that "Coley's toxins have had no effect on the duration of life, either when given alone or combined with other forms of treatment." While they refer to three cases in which the toxins were used, their tables mention only one, and no details are given as to whether it was operable or inoperable. It would seem that this opinion on the value, or lack of value, of Coley's toxins was based upon much too meager personal experience to justify such a broad and unqualified verdict. Certainly even a limited review of the recent literature on bone tumors would have shown that the toxins had proven of great value, not only in my own hands but in those of other men. Without further argument, I am quite willing that my readers shall form their own opinions after reading the end-results obtained in a series of 86 cases personally observed at the Memorial Hospital and the Hospital for Ruptured and Crippled.

END-RESULTS IN 86 CASES OF ENDOTHELIOMA PERSONALLY OBSERVED

Thirty-four cases were *treated by radiation alone.* Only one case remained well for five years, and in this case, unfortunately, there was no microscopic confirmation of the diagnosis. It was pronounced an endothelial myeloma by the Bone Sarcoma Registry solely on the clinical and roentgenologic evidence.

Twenty cases were *treated with toxins alone or toxins and surgery.* Twelve have remained well for from five to twenty-two years. The diagnosis was confirmed by microscopic examination in all but one case; in this, there was a large, rapidly growing, inoperable tumor, involving the upper half of the femur, which had developed in a young boy shortly after an injury. The patient was emaciated and cachectic at the

time treatment was begun. He recovered under toxins alone and is well at present, ten years later. There can be no reasonable doubt of the diagnosis in this case. Of these 12 cases, four were inoperable at the time treatment was begun, and in three cases extensive metastases had already taken place. In four of the cases the limb was saved. Six were treated by toxins and amputation, and two by toxins and resection.

Thirty-two cases were *treated with toxins and radiation.* Nine have remained well for from five to thirteen years. The diagnosis was confirmed by microscopic examination in all but two cases. In one of these a diagnosis of endothelial myeloma was made by the Bone Sarcoma Registry from the clinical and roentgenologic evidence alone, which was quite characteristic. In the other, there was a huge, inoperable tumor involving the upper half of the femur. The condition was beyond hip joint amputation, and was regarded as hopeless by the members of the Memorial Hospital staff. There was a pathologic fracture and destruction of four inches of bone. Under eight months' toxin treatment and one application of the radium pack, the patient made a complete recovery and has remained well for thirteen years. In this case, the tumor had none of the characteristics of a giant-cell sarcoma. Its rapid development and prompt response to toxins and radium, in my opinion, makes the diagnosis of endothelioma reasonably positive. Of the nine recoveries in this last group, five were inoperable when treatment was begun, and in three cases metastases had already occurred.

BRIEF RÉSUMÉ OF INOPERABLE CASES SUCCESSFULLY TREATED

E. M. (Case 10), a male, aged 47 years. Endothelial myeloma of upper two-thirds of the shaft of the humerus following a recent fracture; inoperable; pathologic fracture. Treated with toxins and radium. Fracture re-united and all evidence of disease disappeared. Patient well six and one-half years after the beginning of treatment. Bone Sarcoma Registry Case No. 596.

C. P. (Case 12), a male, aged 28 years. Angio-endothelioma involving the lower end of the tibia and the upper end of the fibula. Intensive roentgen therapy for one year. Developed pulmonary metastasis. Toxin treatment begun in July, 1925. A pathologic fracture had occurred, which failed to unite, and, the leg being useless, an amputation was performed in June, 1926. Intravenous injections of toxins given, with occasional intervals of rest, for a period of two years. Patient in good condition; metastasis held under complete control, as shown by roentgenogram in November, 1929. At that time he had a severe attack of coal-gas poisoning. One month later he went into a coma and died in twenty-four hours. No autopsy; cause of death unknown. Case No. 574 in Bone Sarcoma Registry.

W. L. B., a male, aged 6 years. Endothelial myeloma of femur following a trauma in 1916; amputation by Dr. Stuart McGuire in 1917. One year later extensive metastases developed in right parietal and occipital bones, with marked exophthalmos. Treated with toxins, and radium pack over the parietal bone only. In August and October, 1919, and March, 1920, patient received a radium lead-tray treatment over the right temporal and right parietal regions. In April, 1920, further metastasis developed in the occipital region; patient received two more treatments with radium lead-tray. Toxins kept up for a period of five years. Patient made a complete recovery and is in good health at the present time, over twelve years since the treatment was begun. Case No. 348 in Bone Sarcoma Registry.

C. S., a male, aged 39 years. Malignant tumor involving nearly one-half of the shaft

of the tibia; no new bone formation. Patient referred to me by Dr. John H. Gibbon in April, 1917. Biopsy performed; tumor pronounced a highly malignant osteogenic sarcoma by Dr. Ewing, with which diagnosis the Bone Sarcoma Registry (see Case No. 183) concurred. From March to May patient received three radium pack treatments and systemic toxins. Tumor apparently disappeared. Toxins kept up until August, 1917, when the patient went on his vacation. On his return two months later (October) examination showed extensive metastases in the inguinal, femoral, and iliac glands. A gland was removed and pronounced sarcoma. Three radium pack treatments given from October to December, 1917; toxin treatment resumed and kept up for a period of two and one-half years (did not interfere with the patient's usual routine of life). All evidence of the disease disappeared and the patient remains in good condition, fourteen years since the treatment was begun.

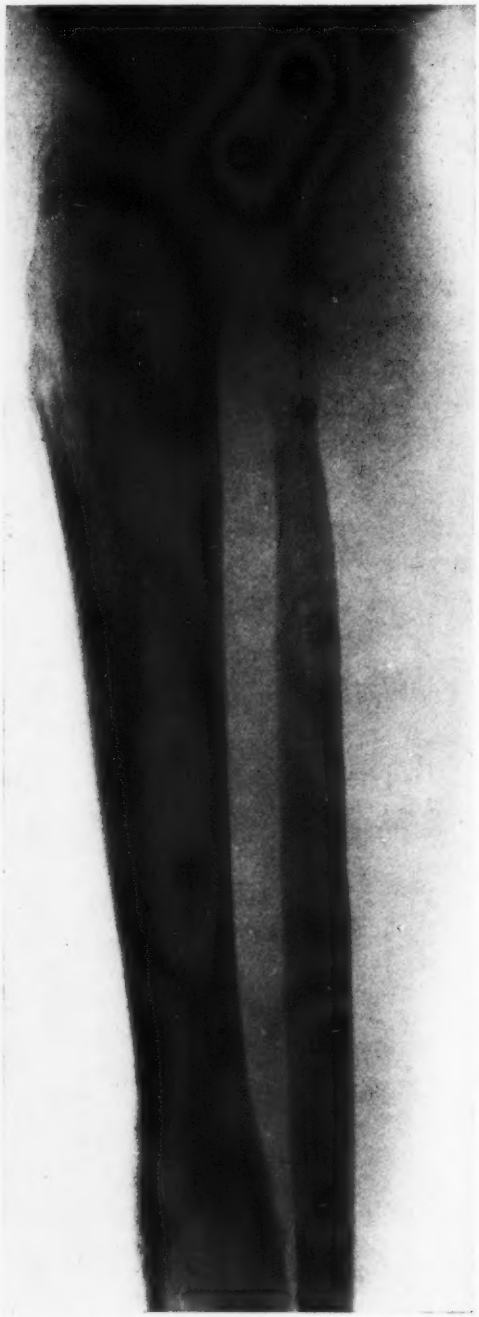

Fig. 22. Another film of Case 12, made two months after Figure 21.

While this case was registered in 1917 as an osteogenic sarcoma, I have come to the conclusion that it should have been classified as an endothelioma, for the following reasons: it was a tumor of the shaft; there was no new bone formation; the tumor as well as the metastases to the regional glands responded promptly to toxins and radium.

H. S. (Case 11), a male, aged 8 years. Endothelial myeloma of the shaft of the fibula, with extensive metastases in the femoral, inguinal, and iliac glands, and probably in the lungs. Diagnosis confirmed by microscopic examination. Toxin treatment given for three months after amputation. One radium pack treatment over groin only. Patient made a complete recovery and is still well, nearly eleven years since the treatment was begun. Case No. 267 in Bone Sarcoma Registry.

G. M., a male, aged 9 years, patient of Dr. George B. Packard, of Denver, Colorado. Sarcoma of upper third of shaft of femur following a recent trauma. Tumor

rapidly growing; had clinical and roentgenographic appearances of endothelioma; inoperable. Patient emaciated and bed-ridden when toxin treatment was begun by Dr. Packard. Complete recovery; no evidence of disease at present, more than ten years after beginning of treatment.

R. H., a male, aged 36 years. Extensive tumor involving middle and upper thirds of shaft of femur following a recent trauma; pathologic fracture; complete destruction of five inches of bone. Roentgenogram of chest suspicious of pulmonary metastasis. Treated with Coley's toxins directly into the tumor and one application of radium pack. Toxins kept up for eight months. Marked diminution in size of tumor; reunion of bone. All evidence of disease disappeared. Patient has a useful limb and for the past eleven years has been carrying on his regular work in a machine factory; is still well, at present over thirteen years since the treatment was begun. Case No. 210 in Bone Sarcoma Registry.

A. G., a male, aged 19 years. Endothelioma involving two-thirds of shaft of femur, with extensive multiple metastases. Original diagnosis (1902), small round-cell sarcoma. Apparent cure by Coley's toxins, after failure of X-ray treatment. Patient had been well ten and one-half years when a malignant tumor (sarcoma and epithelioma) developed in the thigh at the site of an old roengen-ray dermatitis. For full report of this case see *Annals of Surgery*, April, 1913, LVII. Diagnosis in this case confirmed by Dr. E. K. Dunham, Dr. William H. Welch, and Dr. James Ewing.

G. B. (Case 9), a male, aged 31 years. Multiple metastases to bones and soft parts following amputation for sarcoma of tibia in September, 1925. Complete recovery under toxins alone. Patient well at present, more than five years since treatment was begun. Toxins were continued at my suggestion during 1927 and 1928. (See case of Dr. S. L. Christian and Dr. L. A. Palmer in *Military Surgeon*, July, 1927, and *American Journal of Surgery*, February, 1928.) Bone Sarcoma Registry Case No. 1143: Ewing's sarcoma.

Fig. 23. Another film of Case 12, showing pulmonary metastasis (November, 1926).

EARLIER RESULTS

Before closing, I should like to say a word about our early results. In his invitation to the Bone Sarcoma Symposium (Baltimore, September, 1930), Dr. Bloodgood, in a few introductory remarks, stated: "The records of more than three thousand cases of bone diseases and bone tumors which have accumulated in the Surgical Pathological Laboratory of the Johns Hopkins Hospital and University for the last forty years show that up to 1913 there was not a single verified case of sarcoma (cancer of bone) cured by any treatment."

In reviewing our earlier series treated at the Memorial Hospital and the Hospital for Ruptured and Crippled prior to 1913, I find

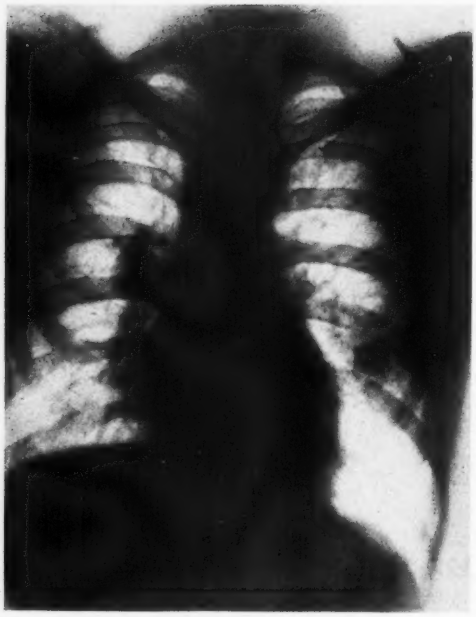

Fig. 24. Another film of the chest of Case 12, made March 21, 1927.

they include 19 cases of bone sarcoma in which the patients have recovered and remained well for from six to thirty-four years; fifteen of these cases have been well for from ten to thirty-four years. In every case a microscopic examination was made by one of the leading pathologists of the country; eight of the lesions were endotheliomas and the rest osteogenic sarcomas.

The only difference in the methods of treatment employed in our group of cases and in that of the Johns Hopkins Hospital and University is that in every one of the recoveries mentioned the toxins of erysipelas and *Bacillus prodigiosus* were used, either alone or in connection with surgery.

ETIOLOGY

As regards the etiology of endothelial myeloma, Ewing[7] states (p. 100): "We have not the slightest conception of how or why the tumors develop. The febrile period in the beginning strongly suggests that an infectious agent may be connected with it, as it is probably connected with lymphosarcoma. I still remain of the opinion that this is a specific disease of bone. With a lack of evidence of some other origin and nature of the tumor it seems best to retain the designation of endothelial myeloma."

While a discussion of the etiology of endothelial myeloma would lead one into the difficult and obscure field of the etiology of malignant tumors in general, I should like to state that, in my opinion, this type of tumor has many features that point very strongly to an extrinsic, that is to say, a microbic cause. These features are: (1) the frequency with which antecedent local trauma is associated with the development of the tumor; (2) the close similarity to osteomyelitis both clinically and roentgenologically, and oftentimes its histological appearance makes it difficult to differentiate it from chronic osteitis or osteomyelitis; (3) its frequent association with rise of temperature (101° to 104°).

While it is true that a history of trauma is found in other types of bone tumors, and, to a lesser degree, in malignant tumors of the soft parts, it shows a rather high percentage, about 50, in endothelioma as well as in osteogenic sarcoma. It is now generally recognized by courts and industrial compensation commissions throughout the world, that antecedent local trauma may be an important causative factor in the development of malignant tumors. No satisfactory explanation of this causative influence has been possible except on the theory that bone sarcomas or malignant tumors in general are due to some extrinsic or microbic cause. If this is granted the explanation is easy: the trauma simply produces a local area of lowered resistance or a favorable soil for the development of the micro-organism which has hitherto been present in the

[7]Proc. New York Path. Soc., January-May, 1924, XXIV, 93.

tissues but quite harmless. Having once gained a foothold, it immediately produces a proliferation of cells, resulting in the formation of a malignant tumor. We know this is true as regards a number of infectious diseases, for example, tuberculosis of bone, or osteomyelitis.

During the past year, Dr. Richard F. Berg, of Portland, Oregon, the holder of the Gibney Memorial Fellowship of the Hospital for Ruptured and Crippled, has been conducting, under my direction, a line of research work on the experimental production of bone tumors in chickens by inoculations of dried Rhode Island Red endothelioma-virus obtained from the laboratory of Dr. Murray, of the Imperial Cancer Research Fund, London. Berg not only repeated the experiments of Connor, of San Francisco,[8] *i.e.*, producing typical endotheliomas in the tibiæ of young chickens, but, by using fresh tumor material for a subsequent series of inoculations, he was finally able to produce five different types of bone tumors having all the clinical, roentgenologic, and microscopic appearances of the different types of bone tumors found in man.

These results I believe to be of extreme importance. If it is possible to produce the different varieties of malignant tumors by a single micro-organism or living virus, then one of the main objections of the pathologists and bacteriologists to the extrinsic origin of cancer has been removed. They have frequently asserted that to assume cancer is caused by a micro-organism entails the assumption of a different micro-organism for the different varieties of malignant tumors.

Fig. 25. Specimen removed, Case 12.

CONCLUSIONS

1. Endothelial myeloma, or Ewing's sarcoma, while usually the most malignant of all types of bone tumor, is both highly radiosensitive and likewise responsive to the toxins of erysipelas and *Bacillus prodigiosus*. For this reason we are justified in trying conservative treatment for a limited period before resorting to amputation.

2. Although a very considerable number of cases have been treated by primary radiation alone, or radiation combined with surgery (34 cases in our own series), so far there has been but one five-year cure, and, unfortunately, in this case there was no microscopic examination to verify the diagnosis.

3. A careful analysis of the end-results of different methods of treatment would

[8] Connor, Charles L.: Experimental Sarcoma of Bone. Arch. Surg., November, 1929, XIX, 794.

seem to warrant us in regarding systemic treatment with the toxins of erysipelas and *B. prodigiosus* (Coley) combined with local radiation, preferably the radium pack, as the best method of treating a primary operable case of endothelioma of the long bones.

4. If the condition has not shown marked improvement at the end of six or eight weeks, then amputation (or resection) followed by prolonged prophylactic toxin treatment should be seriously considered. Further delay without evidence of improvement may result in the development of metastases, with the loss of all hope of saving the life of the patient.

5. The most significant fact brought out by our statistics is the comparatively large number of inoperable cases that have recovered and remained well for five years or more: four treated with toxins alone, and five treated with toxins and radiation. In no less than six of these cases the condition was not only inoperable but extensive metastases (in two cases in the lungs) had already taken place. Therefore, we believe that few cases of endothelioma of bone should be regarded as entirely hopeless until the patient has been given the benefit of a thorough trial of toxin and radium treatment.

OSTEITIS FIBROSA

By FREDERIC J. COTTON, M.D., Boston, Massachusetts

OSTEITIS fibrosa seems a good subject to discuss in order that we may expose ourselves to a chance of learning something about it. Of course, von Recklinghausen's original book, with its marvellous plates, has to do with museum specimens representing a type, or a stage, of presumably systemic disease, at wide variance from what we see in practice. Whether such cases exist in any considerable number with us may be doubted.

What we see—what I see, at least—may be summarized clinically as—

(a) Multiple irregularly scattered bone involvements, sometimes including skull and ribs; sometimes, but not commonly, with cyst formation.

(b) Involvements of one bone only—an enlargement of the shaft sometimes suggesting the characteristic syphilitic changes—an expansion with little change in density, with disappearance of the marrow cavity.

(c) Rather large cysts, near bone ends, with or without other bone involvement, except near the cyst.

All these types may give spontaneous, or at least easy, fractures, which fractures unite.

(d) Cases, sometimes of rapid development, inescapably linked with trauma, sometimes very prompt in appearance and rapid in progress. The bone picture, in X-ray examination, runs close to Ewing's tumor or the non-suppurative Garrè type of osteomyelitis.

Two cases I have seen of this class of slower growth, both due to repeated occupational trauma, showed massive overgrowth, with sclerosis. At operation, both showed ivory bone. One case recovered entirely. The other did equally well for a time, but later showed characteristic Paget's disease in other bones, and died six years later of early senile changes.

(e) What is called osteitis fibrosa of the small bones, Köhler's disease, Preisser's disease, Kienböck's disease, and the rest. The same thing occurs not rarely—though less often than Speed thinks—after fractures of the carpal bones.

There should be a pathologic picture characteristic of fibrous osteitis—there is not!

The cases occurring in carpal or tarsal bones show atrophy, fibrosis, fatty changes, vague unwalled cysts. Obviously, one would say, the result of defective circulation, post-traumatic.

But there is a "catch" to this!

Operate on one of these cases—take out a degenerate semilunar, let us say—and there is *uniformly* a reaction entirely different from that seen when one removes a *dislocated* semilunar—an *inflammatory* reaction and a slow convalescence.

In the other classes the histological picture, save for the occasional cysts, is absolutely characterless; atrophy and hypertrophy, with fibrosis of the interspaces. And what does this tell? Absolutely nothing! One can get just the same slides in a case of Paget's disease. One can get the same thing, absolutely indistinguishable, in parts of a bone with staphylococcus infection (proved) in the vicinity. One gets *nearly* the same thing, microscopically, in the vicinity of giant-cell growths, and *quite* the same thing about the cysts and the fibrosed repair masses that unquestionably are the end-result of giant-cell growths—G. Barrie's hemorrhagic osteomyelitis.

I wonder if we might not do well to cease talking about osteitis fibrosa as a disease, and recognize that the changes reported by the pathologist as osteitis fibrosa mean, not a specific disease at all, but merely evidence

that bone reacts to a *variety of stimuli* by the same sort of changes?

Congenital or endocrine, some of the cases may be—probably are. Mayhap lack of our friend Vitamin D may lie back of some of them. Some represent the reaction to trauma—to one or to many traumas—perhaps often by way of hemorrhage.

In some, the reaction involves molecular bone death, and Mallory's "foreign body giant cells" take up their job of eating dead lime. Sometimes—not always—they get so enthusiastic as to make a giant-cell tumor, so called—really an unruly granulation-mass under pressure, a mass that grows until pressure is relieved, then fibroses or encloses a residual cyst.

Or the same histologic picture confronts us as in Paget's disease, which we now class as pre-senile arteriosclerosis, whether primarily of bone or acting by arteriosclerotic disturbance of the parathyroids: just the same picture microscopically, with atrophy or sclerosis, as may be—in patches often.

Cysts and giant-cell tumors are rarer concomitants of Paget's disease—malignant degenerations are more common.

The point is that the single-bone osteitis fibrosa and Paget's disease are the same thing, too often, histologically or in the X-ray examination.

So with infections. I have two cases in which the shaft changes were osteitis fibrosa, judged by the X-ray or the microscope, but the clean-up operation showed pin-head abscesses deep in the bone, far away from the overgrowth, which yielded *Staphylococci—aureus* in one, *albus* in the other.

Accordingly, I do not believe there is any such disease as osteitis fibrosa, but I do believe *fibrosis in bone, with concomitant changes, to be merely the reaction of bone to various stimuli.*

The name "osteitis fibrosa cystica" will probably continue to be used as a convenient catch-all, meaning as little as "arthritis" or "dyspepsia." The important thing is to be sure of our diagnosis, to be sure we are not dealing with more serious processes. The danger is not, I think, of passing by sarcomas, but of being swept off our feet by the startling pictures that this osteitis fibrosa class sometimes shows. Usually we can discriminate pretty well.

Nevertheless, I am for operation—*radically for operation*—partly because of the chance of mistake, as well as because operative measures may be made of distinct service in many cases of osteitis fibrosa, by removing excess bone, and, in the more acute cases, by checking the spread of the growth, apparently by relieving intra-osseous tension, just as one does with the giant-cell tumors. If one clears away a large share of the overgrowth, or even goes to below normal in reducing bulk, in the cases I have called Class D, post-traumatic, much relief is experienced and the process seems to be checked. Nevertheless, one of the cases I have cited developed minor changes in the other tibia, while one went on to a real, though mild, Paget's disease.

By the way, these are not *atrophic lesions;* quite the reverse, so far as blood supply goes. The operations may even occasion rather startling hemorrhages.

Now as to diagnosis, osteitis fibrosa gives varied pictures.

As between osteitis fibrosa and Paget's disease, we can draw no line—not even that of age.

One used to hear much about "one-bone Paget's" from the X-ray men. I have seen one unquestioned case of one-bone Paget's—one bone only for a long while, at least.

On this matter of differential diagnosis, "osteitis fibrosa or Paget's" is all you care to say about it. Both may show distortion of bone, or over-growth; both may lead to pathologic fracture. Both show union of such fracture—not promptly, but always union. Both show, or may show, multiple

bone involvement. Both may show skull changes, not dissimilar.

Between the two we have two points, and only two, on which to go:

(1) Paget's occurs—or begins—typically, in unfortunate individuals in the early fifties. In younger persons, we lean towards osteitis fibrosa.

(2) Paget's disease shows, variably, a symmetrical involvement of *both* femurs or *both* tibiæ. Irregularly distributed Paget's disease is common enough, and the picture of the "one-bone Paget's" is still met with —and not classified.

The occurrence of skull changes is not conclusive, nor the character of the changes.

Essentially, the differentiation is decided on *clinical* lines. As between osteitis fibrosa and other types, essentially cystic, the question is again one of clinical judgment. I have in mind three cases, all of spontaneous fracture just below the hip. One obviously was the end-result of a giant-cell tumor; another was very similar, but with a good deal of surrounding bone change; the third presented exactly the same local picture, but with pronounced changes in the skull. All three patients were less than thirty-five, and all, by the way, were individuals of at least average vigor and health. One could hardly consider true Paget's disease in any of this group.

There should be no trouble in diagnosis between giant-cell tumor and osteitis fibrosa, though sometimes there is; but between the cyst, end-result of giant-cell growth, and the fibrous repair of either giant-cell tumor or cyst, especially after a spontaneous fracture has opened up the bone and relieved tension, I repeat, between such cases on the one hand and osteitis fibrosa on the other, there may be real difficulty in coming to a conclusion.

The differential diagnosis between a quiet osteomyelitis of the non-suppurative type or a Brodie's abscess (with the not uncommon pale and ill-marked picture of the bone-absorption area) and osteitis fibrosa may well be difficult.

RELATION BETWEEN HISTOLOGIC STRUCTURE AND PROGNOSIS IN SARCOMA OF SKIN AND FASCIA

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COMPARATIVELY little attention has been given to any relationship that may exist between histologic structure and prognosis in sarcoma. Broders (1), through many publications, has proposed a system of grading carcinomas. Plaut (2), in 1927, published a general review of the subject of histologic prognosis. He quotes Virchow (3) as stating that malignancy in sarcoma cannot be decided according to any fixed rule, that one must take into account the individual as well as the organ involved. The review in general deals with carcinomas, and, after summarizing the opinions of nearly all who have expressed themselves on the relationship between structure and ultimate result, Plaut concludes: "I do not consider the time ripe, however, to advocate the method of histologic prognosis for practical purposes." Reimann (4) undertook a detailed histologic analysis of 100 cases of cancer of the breast, and compared the theoretical prognoses thus indicated with the actual result as determined through follow-up records. Since the theoretical prognosis proved to be right in only 50 per cent of the cases he reaches the conclusion that "the grading of a tumor for the individual patient is impossible at present." Recently MacCarty (5) has stated that "any system of microscopic grading of cancer should not alone be of accurate clinical value without taking many other factors into consideration," and that "at present all grading of cancers should be considered in the investigative or experimental stage."

The object of the study herein reported was to determine what, if any, relationship might exist between histologic structure and clinical result in the group of malignant mesoblastic neoplasms (sarcomas, including types commonly designated endotheliomas), exclusive of those of bone. The material was derived entirely from the microscopic sections and clinical histories, including follow-up records, on file in the Surgical Pathological Laboratory of the Johns Hopkins University. This report is based on the first 30 consecutive cases of which both microscopic sections and follow-up records were available.

In analyzing the sections, the degree of cellularity, the relative number of cells having nuclei abnormal in size, and the relative number of nuclei in mitotic division were given numerical values. For the degree of cellularity, these ranged from "0" for a cellularity equal to that of normal subepidermal connective tissue, to "3," for the density of cells in a lymphosarcoma. If no cells had nuclei larger or smaller than normal, abnormal variation in size of nuclei was recorded as "0"; if a moderate number of such cells were observed, a value of "1" was given, and "2" if this feature was marked. Similarly, a "0" recorded that few or no mitotic figures were observed, a "1" that a moderate number were present, and "2" that there were many. The term "malignancy index" was arbitrarily chosen to express the sum of the numerical values of the cellularity, nuclear variation in size, and mitosis for each case.

The 30 cases were then divided into two groups: one, in which the ultimate clinical result was regarded as favorable; the other, as unfavorable. The results are seen in Tables I and II.

TABLE I. CASES WITH FAVORABLE CLINICAL RESULT

P. N. J. H. H.	Type and location	Race	Sex	Age at onset	Pre-operative duration	Operation	Cellularity	Abnormal variation in size of nuclei	Mitosis	Malignancy index	Clinical result
169	Fibrospindle-cell, upper lip	W	F	12	11 yrs.	Complete excision	1	0	0	1	Well, 1 yr.; 10 yrs., not heard from
290	Spindle- and round-cell, floor of mouth	W	M	48	9 mos.	Jaw, with symphysis and one-half of tongue, excised	2	1	0	3	Dead, apoplexy, 5 yrs. 8 mos.
843	Spindle-cell, foot	W	M	24	.....	Excision	2	0	0	2	Paralysis, right side, 20 yrs. later
1274	Fibrospindle-cell, axilla	W	F	34	3 mos.	Incomplete excision	0	0	0	0	No recurrence, 16 yrs.
1308	Psammoma, subcutaneous, shoulder	C	M	45	2 yrs.	Complete excision	2	0	0	2	Dead, 2 yrs., pneumonia; no indication of tumor involvement
1656	Spindle-cell, temporal fossa	W	F	66	2 yrs.	Radical, with cervical glands	1	1	1	3	Well, 7 yrs.
1867	Lymphangiosarcoma, forearm, intermuscular	C	F	8	10 yrs.	Complete excision	2	0	0	2	Well, 16 yrs.
2783	Spindle- and round-cell, skin, face	C	M	54	12 yrs.	Excision, with partial parotid	1	0	0	1	Dead, apoplexy, 5½ yrs.
4751	Fibrospindle-cell, skin, thigh	W	F	25	10 yrs.	Excision, complete	1	0	0	1	Well, 11 yrs.
4762	Fibrospindle-cell, skin, chest	W	M	37	5 yrs.	Complete excision	1	1	0	2	Well, 12 yrs.
5112 5122	Fibrospindle-cell, heel, fascia	W	M	20	4 yrs.	Amputation foot; glands in groin	2	1	0	3	Well, 12 yrs.
5428	Fibromyxospindle-cell, nerve sheath, coccyx	W	F	18	3 yrs.	Removal of coccyx; curettement of tumor	0	0	0	0	Question of recurrence, 19 yrs later
5397	Fibrospindle-cell, skin, lip	W	F	45	.....	Local excision	3	0	0	3	Well, 9 yrs.

TABLE II. CASES WITH UNFAVORABLE CLINICAL RESULT

P.N. J.H.H.	Type and location	Race	Sex	Age at onset	Pre-operative duration	Operation	Cellularity	Abnormal variation in size of nuclei	Mitosis	Malignancy index	Clinical result
637	Perithelial angiosarcoma, skin, chest	W	M	39	4 yrs.	Complete excision	3	1	1	5	Dead, int. metastases, 11 mos.
708	Spindle- and round-cell, back	W	F	41	2 yrs.	Excision	2	1	1	4	Dead, int. metastases, 1½ yr.
1020	Small round-cell, dura	C	M	45	.....	.....	3	0	0	3	Dead, 1¼ yr.
1224	Spindle- and round-cell, skin, leg	W	M	53	3 mos.	Complete excision, with muscle, wide margin	2	1	1	4	Dead, 7 mos., cause unknown
2270	Perithelial angiosarcoma, lumbar fossa	W	F	25	4 mos.	Excision, with rib, muscle, and part vertebra	2	1	0	3	Dead, 6 mos., question of tuberculosis or metastasis
2424	Spindle- and round-cell, lumbar region	W	M	54	1½ yrs.	Exploratory, inoperable	2	1	1	4	Dead, 6 mos.
2547	Fibrospindlemyxosarcoma, lumbar fossa	W	M	53	2 mos.	Partial excision	0	0	0	0	Dead, 2 mos.
2886	Spindle-cell, skin, forehead	W	M	32	2 yrs.	Excision, with lymphatics	2	1	1	4	Dead, 1 yr., internal metastases
3008	Lymphangiosarcoma, thigh	W	F	59	4 wks.	Amputation below trochanter	3	1	1	5	Dead, 5 or 6 mos.
3016	Lymphangiosarcoma, leg, intermuscular	W	F	9	7½ mos.	Amputation, knee, glands along sciatic nerve	3	1	1	5	Dead, few mos., metastases
3793	Perithelial angiosarcoma, skin, neck	W	F	37	2 yrs.	Excision, with cervical glands	2	1	0	3	Dead, 6 mos., recurrence and metastases
4382	Fibromyxosarcoma, nerve sheath, popliteal space	W	F	22	1 yr.	Excision	2	0	0	2	Two recurrences; dead, 5 yrs.
4847	Small round-cell, eyelid and cheek	W	F	4	6 wks.	Complete excision, with enucleation of eye	2	1	1	4	Recurrence; dead 4½ mos.
4904	Spindle- and round-cell, intermuscular, shoulder	W	M	21	6 mos.	Amputation arm, scapula, and half clavicle	1	1	0	2	Dead, 3 mos., internal metastases
4951	Round-cell, skin, thigh	W	F	42	3 yrs.	Excision	2	1	0	3	Dead, 3 mos.; retroperitoneal metas. (explor. lapar.)
5604	Endothelioma, lower jaw	W	M	19	1 yr.	Excision, jaw	2	1	0	3	Recurrence and metastases, 1 yr.; dead, 3 yrs.
5866	Lymphangio-endothelioma, thigh	C	F	34	4½ mos.	Complete excision	2	1	0	3	Recurrence and metastases; dead, few mos.

COMMENT AND CONCLUSIONS

It is seen that the average malignancy index of the 13 cases having a favorable clinical result is 1.7, while the average malignancy index of the 17 cases having an unfavorable clinical result is 3.4, yet in individual cases of either series the relationship of malignancy index to clinical result is not constant. Thus, Case 5,112, a fibrospindle-cell sarcoma of the heel (soft parts), with a malignancy index of 3, was of four years' pre-operative duration, and was well, with no recurrence, when last heard from, twelve years after operation; while Case 2,547, a fibrospindlemyxosarcoma, intermuscular, of the lumbar region, in which death occurred four months after clinical onset, presented a malignancy index of 0. The unreliability of using histologic criteria in estimating prognosis in individual cases is here manifest.

All seven pure fibrospindle-cell sarcomas of this series fall into the favorable result group. Of the pure spindle-cell sarcomas, two are in the favorable group and one in the unfavorable. Four of the six spindle- and round-cell sarcomas, both fibrospindle-myxosarcomas, all three small round-cell sarcomas, all three hemangiosarcomas, and three of the four lymphangiosarcomas are in the unfavorable result group. The two endotheliomas are divided between the two groups.

The average pre-operative clinical duration in the favorable result group is 5.4 years; in the unfavorable result group it is 1.2 year.

In the favorable result group the average age at onset is 33.5 years; in the unfavorable result group it is 34.6 years.

Thanks are extended to Dr. Joseph C. Bloodgood, the use of whose records, materials, and laboratory facilities made this study possible.

REFERENCES

(1) Broders, Albert C.: Squamous-cell Epithelioma of the Lip: A Study of 537 Cases. Jour. Am. Med. Assn., March 6, 1920, LXXIV, 656.
Idem: The Grading of Carcinoma. Minnesota Med., November, 1925, VIII, 726.

(2) Plaut, Alfred: The Relation between the Histologic Picture and Prognosis of Tumors. Arch. Path. and Lab. Med., February, 1927, III, 240.

(3) Virchow, Rudolf: Quoted by Plaut, ibid, p. 241.

(4) Reimann, Stanley P.: The Issues at Stake in the Grading of Tumors. Arch. Path., November, 1929, VIII, 803.
Idem: Bemerkungen über die Bestimmung des Bösartigkeitsgrades von Tumoren auf Grund ihrer histologischen Bilder (The Value of the Malignancy Index in the Prognosis of Tumors). Beitr. z. path. Anat. u. z. allg. Path., 1930, LXXXIV, 266.

(5) MacCarty, William C.: Principles of Prognosis in Cancer. Jour. Am. Med. Assn., Jan. 3, 1931, XCVI, 30.

A STUDY OF BONE TUMORS AMONG EX-SERVICE MEN

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THE clinical incidence of bone sarcoma has been estimated at 1 case per 100,000 of the living population (1); accordingly, there are approximately 1,200 persons with bone sarcoma alive at any one time in the United States. With a living World War veterans' population estimated at 4,330,598, the number of cases of bone sarcoma among ex-service men is small. However, on account of the prevalence of other types of bone tumors, and the various inflammatory as well as degenerative diseases of bones, it is desirable that the differential diagnosis of the different forms of bone disease, as well as their proper treatment, be thoroughly understood.

Thanks to the untiring efforts and labor of such men as Codman, Bloodgood, and Ewing, and as the result of the establishment of the Registry of Bone Sarcoma, data regarding this subject have been compiled and have been made available to the profession. The clinical, X-ray, and pathological research work done has resulted in a more scientific, a more rational as well as a more practical viewpoint regarding the classification, criteria for diagnosis, treatment, and the prognosis of bone tumors.

The present study is the result of an analysis of the histories of 45 cases of bone tumor among ex-service men. Some of the patients incurred the disability during the World War, others soon after their discharge from the military service. These patients were treated in Government and civilian hospitals. There was a lack of uniformity of certain of the data in the clinical histories of these cases, so that much of the information was difficult of statistical treatment. Nevertheless, in spite of this fact, the study reveals a considerable amount of important information concerning the subject under consideration.

CLASSIFICATION OF BONE TUMORS

The classification and the criteria for diagnosis used in this study are those recommended by the Committee of Registry of Bone Sarcoma. A review of Table I shows that 38, or 84.5 per cent, of the total number were cases of osteogenic sarcoma; 5, or 11.1 per cent, were benign giant-cell tumors; there was one case of unclassified sarcoma (extra-periosteal), and one case of benign osteogenic tumor.

The cases were also classified according to whether they were central or periosteal in origin. It was found that 2 of the bone tumors were central in origin, while 17 were periosteal in origin. In 26 cases the origin of the tumor was not recorded.

TABLE I.—CLASSIFICATION OF FORTY-FIVE CASES OF BONE TUMOR

Type of bone tumor	Number	Percentage
Osteogenic sarcoma	38	84.5
Unclassified sarcoma (extra-periosteal)	1	2.2
Benign giant-cell tumor	5	11.1
Benign osteogenic tumor	1	2.2
Total	45	100.0

HISTOPATHOLOGY

It was previously indicated that these 45 cases were under treatment in a number of Government and civilian hospitals, so that the classification of the bone tumor, the criteria for diagnosis, and the microscopic interpretation of the stained tissue specimens were varied, making it difficult to arrive at an agreement of the divergent opinions for purposes of statistical analysis. However, in spite of these difficulties, the cases were

properly classified, both according to clinical criteria and upon the basis of cell structure.

According to the type of cells found in the stained sections, ten of the 45 cases were of the spindle-cell type of sarcoma; eight were of the mixed-cell variety; six of the cases of bone tumor showed a predominance of giant cells, one of these being an osteogenic sarcoma while five were cases of benign giant-cell tumor; one of the cases showed the characteristic histology of a benign osteogenic tumor, and in twenty cases the type of cell was either unrecorded or was described in a manner which made it impossible to properly classify the cellular structure. (See Table II.)

TABLE II.—HISTOPATHOLOGY OF FORTY-FIVE CASES OF BONE TUMOR

	Type of Cell					
Type of bone tumor	Spindle	Mixed	Giant	Bone and cartilage	Unclassified	Total
Osteogenic sarcoma	9	8	1		20	38
Unclassified sarcoma (extra-periosteal)	1					1
Benign giant-cell tumor			5			5
Benign osteogenic tumor				1		1
Total	10	8	6	1	20	45

FAMILIAL OR HEREDITARY HISTORY OF MALIGNANCY

An attempt was made to ascertain whether or not there was a familial or hereditary history of malignancy in general or of sarcoma in particular among the cases studied. A review of the histories elicited the fact that in sixteen instances there was a negative history, and in twenty-nine instances the information on the subject was unrecorded; in not a single case was there a positive family history of either malignancy or sarcoma.

The consensus of modern opinion regarding the etiology of malignancy is that there is a general constitutional malignant-disease-susceptibility which is inherited, and that this quality may manifest itself in different forms in different families. Furthermore, the members of the family possessing the malignant-disease-susceptibility do not all possess the same degree of strength of the malignant-disease-predisposition: in some members of the family the malignancy may appear early, and in other members of the same family malignant-disease-susceptibility may not show itself until very late in life.

In addition to this hereditary susceptibility to malignant disease, there are two other factors which play important rôles in the development of malignancy: (1) organ or tissue predisposition; (2) the extrinsic factor (irritation), which may not always be present.

THE RÔLE OF TRAUMA

In reviewing the clinical records of the 45 cases it was found that 13, or 28.9 per cent, gave a positive history of trauma; in one case there was a definite negative history, and in 31, or 68.9 per cent, of the cases the clinical records gave no evidence one way or the other.

The relationship of trauma to the development of bone sarcoma is not thoroughly understood. The hypothesis formulated to explain this relationship is based upon the fact that when the growing organism reaches its adult age or the terminal stage of physical development, the growth tendency of the tissue cells is interfered with so that no advanced growth is possible. This phenomenon of the tissue cells is known as "growth restraint."

Trauma, with the consequent necessity of repair, leads to a temporary elimination of the quality of "growth restraint," with resulting acceleration of regenerative processes and a multiplication of the mesoblastic cellular elements. It must be understood that not all cases of bone sarcoma are preceded by trauma nor are all traumas of bone followed by the development of sarcoma. The small percentage of cases of bone fracture followed by malignancy confirms the latter view and is a strong argument against the opinion that bone sarcoma is invariably preceded by trauma.

What, then, is essential for a sarcoma to develop after a bone has been traumatized? According to the same hypothesis, which is based upon both clinical data of human cases and work upon animals, it is necessary for the subject to possess a constitutional susceptibility to malignant disease—an inherited property. In addition, there must be a tissue or organ predisposition to malignant disease. The latter is a common observation in cases of bone sarcoma in which it is found that certain particular bones are more susceptible than are others.

In the course of the study an attempt was made to learn the length of time elapsing between the trauma and the first symptoms or signs of bone tumor in the thirteen cases giving a positive history of injury. This information is recorded in Table III. It will be noted that the time varied from less than one month to as long as forty months. In this connection it must be pointed out that the date of the first diagnosis of bone tumor is not the date of the inception of the growth. The latter is, at first, a histologic phenomenon and cannot be demonstrated clinically. When the malignant disease is recognized, either by subjective or objective symptoms or signs, it has attained an advanced stage and has progressed beyond the period of inception.

AGE INCIDENCE

The age of the 45 ex-service patients at the time of the diagnosis of bone tumor may be noted by referring to Table IV. Taking the group as a whole, it is found that 19 years was the minimum age at the time of diagnosis; 32 years was the maximum age, and 24.7 years was the average age.

Of the thirteen living cases, the youngest was 31 years of age (on November 1, 1930, the date of this study); the oldest was 42 years of age, and the average age of the living group was 37 years.

Of the 32 patients who had died, the youngest was 22 years of age; the oldest was 34 years, and the average age of the group was 27.4 years.

DISTRIBUTION OF BONE TUMORS

Kolodny (1) found that the bone most frequently affected with osteogenic sarcoma

TABLE III.—LENGTH OF TIME BETWEEN TRAUMA AND FIRST SYMPTOMS OR SIGNS OF BONE TUMOR

	Osteogenic sarcoma				Benign giant-cell tumor	Total
	Spindle cell	Mixed cell	Giant cell	Cell unclassified		
1 month or less				1	1	2
3 months		1				1
4 months				1	1	2
5 months			1			1
6 months	1			1		2
11 months		1				1
13 months		1		1		2
24 months		1				1
40 months				1		1
Total	1	4	1	5	2	13

TABLE IV.—MINIMUM, MAXIMUM, AND AVERAGE AGE AT *(a)* TIME OF DIAGNOSIS, *(b)* ON NOVEMBER 1, 1930, IN LIVING CASES, AND *(c)* AT DEATH, IN PATIENTS WHO DIED

	At time of diagnosis				As of November 1, 1930 (living cases)				At time of death (patients who had died)			
	No. cases	Minimum age	Maximum age	Average age	No. cases	Minimum age	Maximum age	Average age	No. cases	Minimum age	Maximum age	Average age
Osteogenic sarcoma	38	19	32	24.9	7	31	42	38.0	31	22	34	27.4
Unclassified sarcoma (extra-periosteal)	1	20	20	20.0					1	29	29	29.0
Benign giant-cell tumor	5	21	31	24.8	5	33	42	36.0				
Benign osteogenic tumor	1	23	23	23.0	1	35	35	35.0				
Total	45	19	32	24.7	13	31	42	37.0	32	22	34	27.4

is the femur; the next most frequently involved bones are the tibia and humerus. Geschickter and Copeland (*2*), in a study of giant-cell tumors, found that the femur, humerus, and tibia were the most frequently affected bones.

A study of Table V shows that in the group of 45 cases of bone tumor the left

TABLE V.—BONE INVOLVED

Bone involved	Osteogenic sarcoma				Unclassified sarcoma (extra-periosteal)	Benign giant-cell tumor	Benign osteogenic tumor	Total
	Spindle cell	Mixed cell	Giant cell	Cell unclassified				
Right femur			1	3		3		7
Left femur	4	3		6			1	14
Right tibia	1	1		4				6
Left tibia		2		2		1		5
Right humerus	1							1
Left humerus	1							1
Right fibula	1							1
Right tibia and right fibula				1				1
Left tibia and left fibula		1						1
Right tibia and right os calcis		1						1
Right humerus, right ulna, and right radius					1			1
Left humerus and left scapula						1		1
Right ilium				1				1
First metatarsal bone, right				1				1
First cuneiform and first metatarsal bone, right				1				1
Cuboid bone, left foot	1							1
Third rib, left				1				1
Total	9	8	1	20	1	5	1	45

TABLE VI.—BONES INVOLVED, ALSO SITES OF PREDILECTION

	Osteogenic sarcoma				Unclassified sarcoma (extra-periosteal)	Benign giant-cell tumor	Benign osteogenic tumor	Total
	Spindle cell	Mixed cell	Giant cell	Cell unclassified				
Right femur:								
Upper one-third						1		1
Middle one-third				1				1
Lower one-third			1	1		2		4
Unrecorded				1				1
Left femur:								
Upper one-third							1	1
Middle one-third				1				1
Lower one-third	4	3		5				12
Right tibia:								
Upper one-third				3				3
Middle one-third	1							1
Lower one-third		1						1
Unrecorded				1				1
Left tibia:								
Upper one-third		2		2		1		5
Right humerus:								
Upper one-third	1							1
Left humerus:								
Upper one-third	1							1
Right fibula:								
Upper one-third	1							1
Right tibia and right fibula:								
Unrecorded				1				1
Left tibia and left fibula:								
Lower one-third		1						1
Right tibia and right os calcis:								
Lower one-third, right tibia		1						1
Right humerus, ulna, and radius:								
Lower one-third, right humerus and upper one-third, right radius and ulna					1			1
Left humerus and left scapula:								
Upper one-third, left humerus						1		1
Right ilium:								
Unrecorded				1				1
First metatarsal bone, right:								
Unrecorded				1				1
First cuneiform and first metatarsal bone, right:								
Unrecorded				1				1
Cuboid bone, left foot:								
Unrecorded	1							1
Third rib, left:								
Unrecorded				1				1
Total	9	8	1	20	1	5	1	45

femur was affected fourteen times, and the right femur seven times. The right tibia was affected in six instances and the left tibia in five. The right and left humeri were each affected once.

It is thus seen that the femur was affected in 46.7 per cent of the 45 cases, the tibia in 24.5 per cent, and the humerus in 4.4 per cent.

Of the five cases of benign giant-cell

tumor, three were in the right femur, one in the left tibia, and one in the left humerus and left scapula.

PORTION OF BONE INVOLVED

Meyerding (3), in a study of a group of cases of sarcoma of bone at the Mayo Clinic, found that the most common sites were in the lower end of the femur, the upper end of the tibia, and the upper end of the humerus. Kolodny (1) states that the bone most frequently involved is the femur and the seat of predilection is in the lower metaphysis of this bone; the second most frequent bone involved is the tibia and the most common portion of the bone affected is the upper end; the humerus is next most frequently involved, and the upper third of the bone is the most common site of the tumor.

Geschickter (4), in a study of a large group of bone tumors, found bone sarcoma most frequent in the lower portion of the femur, the upper portion of the tibia, and the upper portion of the humerus. This observer found giant-cell tumors most frequent in the upper end of the tibia, the lower end of the radius, and the lower end of the femur.

A review of Table VI shows that in the group of 45 cases studied the most frequent site of bone tumor is the lower end of the femur; the next most frequent site is the upper end of the tibia.

The localization of most osteogenic sarcomas about the knee, which is frequently exposed to trauma, causes Kolodny (1) to state that trauma is a definite factor in the causation of this condition.

RECURRENCES OR EXTENSIONS

Bone tumors, particularly osteogenic sarcomas, are characterized by the property of invading normal tissues. This fact is illustrated in Table VII, in which it is shown that, of the 45 cases studied, eleven, or 24.4 per cent, gave evidence of an extension or a recurrence of the tumor. It is of interest to know that one case of unclassified sarcoma, five cases of benign cell tumor, and one case of benign osteogenic tumor showed no evidence of extensions or recurrences.

The fact that osteogenic sarcomas will extend or will recur after excision makes it highly desirable that in any operative procedure used in their treatment there must be a complete removal of the affected bone, in order to insure against future recurrence in the stump or in adjacent bones or soft parts.

Table VIII illustrates the bone of origin as well as the site of extension or recurrence of the eleven cases of osteogenic sarcoma under consideration. It is noted that in five instances the recurrence was in the stump; the remaining six cases gave evidence of an extension or recurrence in the bones or tissues adjacent to the site of origin of the sarcoma.

METASTASES

Metastatic deposits of osteogenic sarcoma may occur in organs of the abdominal cavity, in the brain, in bones, in the skin, and occasionally in the regional lymph nodes. The most common site of metastasis is the lungs. These metastases usually occur during the first two years after the onset of symptoms of osteogenic sarcoma (1).

The opinion prevails that metastases are spread through the medium of the blood stream, but in isolated instances it has been noted that the lymphatic system was the factor in the spread of the sarcoma.

Table IX shows that, of the 45 cases of bone tumor studied, 25, or 55.6 per cent, showed the presence of metastases. It is of interest to note that one of the cases showing the presence of metastases was an osteogenic sarcoma in which the microscopic study of the sections showed the giant cell to be the predominant type of cell. There

TABLE VII.—TYPE OF BONE TUMOR AND PRESENCE OR ABSENCE OF EXTENSIONS OR RECURRENCES

Type of bone tumor	No. cases having extensions or recurrences	No. cases without extensions or recurrences	Total
Osteogenic sarcoma:			
Spindle cell	3	6	9
Mixed cell	3	5	8
Giant cell	0	1	1
Cell unclassified	5	15	20
Unclassified sarcoma (extra-periosteal)	0	1	1
Benign giant-cell tumor	0	5	5
Benign osteogenic tumor	0	1	1
Total	11	34	45
Percentage	24.4	75.6	100.0

TABLE VIII.—BONE OF ORIGIN AND SITE OF EXTENSION OR RECURRENCE IN ELEVEN CASES OF BONE TUMOR

Bone of origin	Site of extension or recurrence							Total
	Stump	Right scapula and right clavicle	Tissues of left leg	Right femur and bony pelvis	Right foot	Right femur	Chest from first rib to upper border fourth rib and into left lung	
Osteogenic sarcoma Spindle cell:								
Left femur	1							1
Right fibula	1							1
Right humerus		1						1
Mixed cell:								
Left femur	2							2
Left tibia			1					1
Cell unclassified:								
Left femur	1							1
Right tibia				1				1
Right ilium						1		1
First cuneiform, right, and first metatarsal bone, right					1			1
Third rib, left							1	1
Total	5	1	1	1	1	1	1	11

were five cases of giant-cell tumor which did not give any evidence of metastasis. The highest incidence of metastasis is noted in the eight cases of mixed cell osteogenic sarcoma, in which six, or 75 per cent, showed the presence of metastatic foci.

A review of Table X shows that the 25 cases of osteogenic sarcoma gave evidence of 48 metastases, which means an average of 1.8 metastatic foci in each case. The most frequent sites were the lungs and the inguinal, axillary, and abdominal lymph nodes. This is of interest inasmuch as the opinion prevails that the lymph nodes are

TABLE IX.—TYPE OF BONE TUMOR AND PRESENCE OR ABSENCE OF METASTASES

Type of bone tumor	No. cases having metastases	No. cases without metastases	Total
Osteogenic sarcoma: Spindle cell	6	3	9
Mixed cell	6	2	8
Giant cell	1	0	1
Cell unclassified	12	8	20
Unclassified sarcoma (extra-periosteal)	0	1	1
Benign giant-cell tumor	0	5	5
Benign osteogenic tumor	0	1	1
Total	25	20	45
Percentage	55.6	44.4	100.0

seldom involved. The liver was involved in four instances. It is also of interest to note that metastases occurred in bones in twelve instances.

DIAGNOSTIC SYMPTOMS AND SIGNS

Bloodgood (5) considers localized pain and swelling the predominant symptoms of onset of osteogenic sarcoma. Meyerding (6), in a study of a group of 109 cases of sarcoma of bone, found that the most constant symptom was mild, boring pain; local swelling was also present, as was early evidence of disturbed circulation, such as enlarged veins over the tumor. Meyerding observed that patients continue to be up and around, and were not disabled until either the tumor became large or pathological fracture had occurred. Kolodny (1) found that pain and swelling were the first symptoms noted in approximately one-third of all cases of osteogenic sarcoma. These symptoms were present in the cases studied about one month after a history of injury.

Kolodny (7) holds that the diagnosis of bone sarcoma rests upon a careful consideration of the findings accumulated from all three angles of study, the clinical, roentgenological, and pathological. Occasionally the history and clinical picture will suffice to establish the diagnosis without the necessity of X-ray or histological study. Not infrequently the roentgenogram will suggest the correct diagnosis. In a number of instances even a most careful study of available clinical, X-ray, and histological data will prove insufficient to establish the diagnosis.

In reviewing the diagnostic symptoms and signs recorded in the histories of the group under discussion it was noted that pain and swelling were present in twenty instances, pain alone in seven instances, swelling in six instances. Another symptom or sign noted in the histories was partial or total loss of function.

It was also noted that in nineteen instances the X-ray findings were suggestive of bone tumor. In twenty-six instances there was no record of a roentgenological examination.

TREATMENT

Meyerding (6) advises the exploration of the tumor before amputating the limb. He states that many radical operations have been performed and limbs needlessly sacrificed because of failure to explore. He says that if metastases are ruled out, the treatment is determined to a certain extent by the duration, site, and extent of the lesion. If the treatment is non-operative, Coley's toxins, radium, and X-ray should be administered. If surgery is indicated, the growth may be destroyed locally by cautery, by excision, by excision and cau-

TABLE X.—BONE OF ORIGIN AND SITE OF METASTASIS IN TWENTY-FIVE CASES OF OSTEOGENIC SARCOMA

Bone of origin	No. cases	Lung	Right pleura	Inguinal lymph nodes	Axillary lymph nodes	Abdominal lymph nodes	Pelvis	Rib	Jaw	Ilium	Acetabulum	Right femur	Sacrum	Right humerus	Skull	Vertebræ	Mediastinum	Abdominal cavity	Spleen	Liver	Skin	Bladder	Kidney	Sacro-iliac joint	Total
Osteogenic sarcoma																									
Spindle cell																									
Left femur	2	1			1		1	1									1								5
Right tibia	1								1																1
Right humerus	1	1																							1
Left humerus	1	1																							1
Right fibula	1	1																1							2
Mixed cell																									
Left femur	3		1	2		1													1						5
Right tibia	1	1																							1
Left tibia	1	1		1																					2
Right tibia and os calcis	1	1																	1	1	1				4
Giant cell																									
Right femur	1	1																					1		2
Cell unclassified																									
Right femur	1	1																		1					2
Left femur	2	2																							2
Right tibia	3	2								1												1			4
Left tibia	2	1		1						1	1													1	5
Right ilium	1													1	1	1									3
First metatarsal, right	1	1		1													1			1					4
First cuneiform, right, and first metatarsal	1	1										1	1												3
Third rib, left	1															1									1
Total cases	25																								
Total metastases		16	1	5	1	1	1	1	1	2	1	1	1	1	1	2	2	1	1	4	1	1	1	1	48

tery, or by amputation, followed by non-operative measures such as irradiation and Coley's toxins. In the experience of Meyerding, amputation and closure without drainage constitute the most certain means of disposing of the tumor. Local application of radium or X-ray over the chest, and Coley's toxins are advised following operation.

Bloodgood (8) refers to five cases of bone sarcoma treated by irradiation with good results. He treats giant-cell tumors generally by means of curettement and cauterization. Sarcomas of bone are treated by resection or amputation. In 1921 the percentage of 5-year cures following amputation or resection for osteogenic sarcoma was 4 per cent, and in 1929 it was 35 per cent (9). In the experience of Bloodgood, the 5-year cures by amputation did not include any cases of the upper extremity or scapula, and of the lower extremity only up to the middle third of the femur. There are no records of cures of sarcoma of the upper third of the femur by either amputation or irradiation.

A study of Table XI reveals the type of surgical or non-surgical treatments administered in the 45 cases in the group; the average period of time elapsing from the date

of the first symptoms to the date of the first treatment; also the average period of time up to November 1, 1930, the living patients underwent treatment, and to the date of death of those patients who died.

It is noted that in the case of thirty-eight patients with osteogenic sarcoma, amputation was the treatment in twenty-eight instances, and of this number five, or 17.8 per cent, are alive. In the case of five patients with benign giant-cell tumor whose treatment consisted of amputation, all were alive as of November 1, 1930.

Disarticulation was used as a surgical measure in three cases of osteogenic sarcoma, and of these but one was alive as of November 1, 1930. Disarticulation was resorted to in the case of the patient with unclassified sarcoma, with a fatal outcome. It was the surgical procedure in the case of a patient with a benign giant-cell tumor and also in a case with a benign osteogenic tumor, in which instances the outcome was favorable.

Resection of the bone was resorted to in two cases of osteogenic sarcoma with fatal results. It was the treatment used in a case of benign osteogenic tumor with a favorable outcome.

Excision of the tumor was the treatment used in two cases of osteogenic sarcoma, one of which is alive. It was also used in the treatment of a case of benign giant-cell tumor, with a favorable outcome.

Curettement was used as a surgical measure in four cases of osteogenic sarcoma, of which number but one is alive. It was also used in two cases of benign giant-cell tumor, both of which are still alive.

There were but two patients with osteogenic sarcoma who received either X-ray or radium treatment alone, both of whom died.

There were sixteen patients with osteogenic sarcoma who received either X-ray or radium treatment or both, in addition to undergoing some surgical operation, and of this number but two are alive. One case of benign giant-cell tumor and one case of benign osteogenic tumor received radium or X-ray therapy or both, in addition to undergoing some surgical operation. Both of these cases are alive.

Three patients with osteogenic sarcoma received treatment with Coley's toxins. Two of these underwent a surgical operation in addition, with favorable results. One of the patients with osteogenic sarcoma, whose treatment consisted only of Coley's toxins, died.

Of the group of thirteen living cases, it is noted that the average time between the appearance of symptoms and first treatment was 15.5 months. In the case of the thirty-two patients who died, the average time was 12.8 months. This means that the fatal cases were more rapid in their course, *i.e.*, the diagnosis was made sooner and the treatment administered earlier than in the patients who lived.

The average period of time of the thirteen living cases from the date of the first treatment to November 1, 1930, the date of this study, was 122.6 months. In the case of the thirty-two patients who died, the average period of time from the date of first treatment to the date of death was 21.4 months, the range being from 4 to 86 months.

Of the group of thirteen living cases, the average period from the date of first symptoms to November 1, 1930 (15.5 + 122.6 months), was 138.1 months. The range was from a minimum time of 121 months to a maximum time of 161 months. Among the thirty-two patients who died, the average period of time from the date of first symptoms to date of death (12.8 + 21.4 months) was 34.2 months. The range was from a minimum time of 3 months to a maximum time of 113 months.

RESULTS OF TREATMENT

A study of Table XII indicates the re-

TABLE XI.—TYPE OF TREATMENT ADMINISTERED, AVERAGE PERIOD OF TIME FROM DATE OF FIRST SYMPTOMS TO FIRST TREATMENT, ALSO AVERAGE PERIOD OF TIME PATIENT UNDERWENT TREATMENT TO NOVEMBER 1, 1930 (LIVING CASES), OR TO DATE OF DEATH

Type of treatment	No. cases studied	Average period of time from first symptoms to first treatment				Average period of time patient underwent treatment to Nov. 1, 1930 (living cases), or to date of death			
		Living		Dead		Living		Dead	
		No. cases	Average period of time (mo.)	No. cases	Average period of time (mo.)	No. cases	Average period of time (mo.)	No. cases	Average period of time (mo.)
Osteogenic sarcoma									
Amputation	14	3	21.0	11	8.2	3	111.7	11	18.4
Excision and amputation	1			1	6.0			1	12.0
Resection	1			1	Unrec.			1	22.0
Disarticulation	1	1	13 da.			1	142.0		
X-ray and amputation	3			3	33.3			3	16.7
Curettement, amputation, and X-ray	1			1	1.0			1	25.0
X-ray and resection	1			1	12.0			1	4.0
Amputation, disarticulation, and X-ray	1			1	18.0			1	55.0
Radium and amputation	2			2	10.5			2	14.0
Radium and disarticulation	1			1	8.0			1	38.0
Excision, curettement, radium, and Coley's toxins	1	1	5.0			1	127.0		
X-ray, radium, and amputation	3	1	27.0	2	5.5	1	108.0	2	17.0
X-ray, radium, curettement, and amputation	2			2	17.0			2	9.0
X-ray, radium, amputation, and Coley's toxins	1	1	81.0			1	80.0		
X-ray	1			1	Unrec.			1	Unrec.
X-ray and radium	1			1	Unrec.			1	Unrec.
Coley's toxins	1			1	Unrec.			1	Unrec.
Unrecorded	2			2				2	
Unclassified sarcoma (extra-periosteal)									
Disarticulation	1			1	27.0			1	86.0
Benign giant-cell tumor									
Amputation	2	2	2.5			2	133.5		
Curettement and amputation	1	1	1.0			1	145.0		
Excision, amputation, and disarticulation	1	1	6.0			1	126.0		
Curettement, amputation, and X-ray	1	1	15.0			1	118.0		
Benign osteogenic tumor									
X-ray, radium, resection, and disarticulation	1	1	3 da.			1	146.0		
Total	45	13	15.5	32	12.8	13	122.6	32	21.4

sults of treatment of the 45 cases of bone tumor by type of tumor. It is noted that of the thirty-eight cases of osteogenic sarcoma seven, or 18.4 per cent, are alive, and thirty-one, or 81.6 per cent, are dead; one case of unclassified sarcoma is dead; five cases of giant-cell sarcoma are alive; one case of benign osteogenic sarcoma is

TABLE XII.—PRESENT STATUS OF FORTY-FIVE CASES OF BONE TUMOR

Type of bone tumor	No. living (as of November 1, 1930)	No. dead	Total
Osteogenic sarcoma:			
Spindle cell	2	7	9
Mixed cell	1	7	8
Giant cell	0	1	1
Cell unclassified	4	16	20
Total (osteogenic sarcoma)	7	31	38
Percentage	18.4	81.6	100.0
Unclassified sarcoma (extra-periosteal)	0	1	1
Benign giant-cell tumor	5	0	5
Benign osteogenic tumor	1	0	1
Total (other than osteogenic sarcoma)	6	1	7
Percentage	85.7	14.3	100.0
Grand total	13	32	45
Percentage	28.9	71.1	100.0

TABLE XIII.—AFTER-HISTORY OF THIRTEEN LIVING CASES OF BONE TUMOR

Type of bone tumor	Length of time patient has survived bone tumor				Total
	10 years	11 years	12 years	13 years	
Osteogenic sarcoma:					
Spindle cell		1		1	2
Mixed cell		1			1
Cell unclassified	1	3			4
Benign giant-cell tumor	2	2	1		5
Benign osteogenic tumor			1		1
Total	3	7	2	1	13

alive. Accordingly, of the group of bone tumors other than osteogenic sarcoma, seven cases in all, six, or 85.7 per cent, are alive, and one, or 14.3 per cent, is dead.

Considering the whole group of 45 cases of bone tumor, thirteen, or 28.9 per cent, are alive, and thirty-two, or 71.1 per cent, are dead.

PERIOD OF INVOLVEMENT

Table XIII indicates the length of time the thirteen living cases have survived bone tumor. Of the seven cases of osteogenic sarcoma, one has survived the disease ten years, five have had the disease for eleven years, and one for thirteen years.

Of the five cases of benign giant-cell tumor, two have survived the disease for ten years, two for eleven years, and one for twelve years.

One case of benign osteogenic tumor has survived the disease for twelve years.

There were thirty-two patients with bone tumor who died. Thirty-one were cases of osteogenic sarcoma and one was a case of unclassified sarcoma. Table XIV shows that of the thirty-one cases of osteogenic sarcoma, the duration of the disease was from less than one year in three instances to a period of from six to seven years in four instances. In twelve cases, which was

TABLE XIV.—AFTER-HISTORY OF THIRTY-TWO CASES OF BONE TUMOR WHO DIED

Type of bone tumor	Period of involvement before death								Total
	Less than 1 year	1–2 years	2–3 years	3–4 years	4–5 years	5–6 years	6–7 years	9 years	
Osteogenic sarcoma: Spindle cell	1	1	3	1			1		7
Mixed cell		2	1	1	1		2		7
Giant cell			1						1
Cell unclassified	2	4	7	1		1	1		16
Total osteogenic sarcoma	3	7	12	3	1	1	4		31
Unclassified sarcoma (extra-periosteal)								1	1
Grand total	3	7	12	3	1	1	4	1	32

the largest number, the duration of the disease was from two to three years.

There was one case of unclassified sarcoma in which the duration of the disease was nine years.

EFFECT OF TRAUMA UPON FINAL OUTCOME OF CASES OF BONE TUMOR

A study was made to ascertain if there was a relationship of trauma to the final outcome of cases of bone tumor. It was found that of the thirteen cases with a positive history of trauma four, or 30.8 per cent, died; and of the thirty-two cases with no history of trauma nine, or 28.1 per cent, died. It is thus seen that trauma does not influence the final outcome of cases of bone tumor.

CAUSES OF DEATH

In reviewing the clinical records of the thirty-two cases of bone tumor who died, for the specific cause of death, it was found that in nearly all instances metastases resulting from the original tumor or the original tumor itself was the cause of death. In a few cases the death was due to a contributory condition not related to the neoplasm, such as acute myocarditis, hydropneumothorax, or chronic nephritis.

SUMMARY AND CONCLUSIONS

1. The present study is an analysis of 45 cases of bone tumor among ex-service men. Of the group studied, thirty-eight, or 84.5 per cent, were osteogenic sarcoma; five, or 11.1 per cent, were cases of benign giant-cell tumor; one was a case of unclassified sarcoma, and one was a case of benign osteogenic tumor.

2. According to the histologic structure of the predominant cell of the tumors, ten of the cases were of the spindle-cell type; eight were of the mixed-cell type; six were giant-cell tumors (five benign and one osteogenic sarcoma); one case showed the characteristic bone and cartilage cells of a benign osteogenic tumor, and in twenty instances the predominant type of cell was not recorded, the microscopic diagnosis having been recorded as sarcoma.

3. Thirteen of the 45 cases of bone tumor gave a history of trauma prior to the inception of the disease. The length of time between the injury and the first symptoms or signs of a tumor varied from less than one month to forty months. In the majority of cases the bone tumor was noted within one year after the patient sustained the injury.

4. The average age of the 45 patients at the time of the diagnosis of bone tumor was

24.7 years—the youngest patient was 19 years and the oldest 32 years of age.

Of the thirteen patients who were alive at the time of this study (November 1, 1930), the youngest was 31 years of age, the oldest was 42 years of age, and the average of the living patients was 37 years.

Of the thirty-two patients who had died, the youngest was 22 years of age, the oldest was 34 years, and the average age at death was 27.4 years.

5. In studying the distribution of bone tumors in the group of 45 cases it was found that the femur was affected in 46.7 per cent, the tibia in 24.5 per cent, and the humerus in 4.4 per cent.

Of the five cases of benign giant-cell tumor, three were in the right femur, one in the left tibia, and one was in the left humerus and left scapula.

The most frequent sites of the bone tumors were the lower end of the femur and the upper end of the tibia. The fact that the portions of the bones at or near the knee are most frequently affected with bone tumor, and because this part of the body is frequently subjected to injury, has led many observers to maintain that trauma is a definite factor in the causation of bone tumor.

6. Osteogenic sarcomas are characterized by the ability to extend to or to invade normal tissues, as well as to recur after excision. In the group of 45 cases, eleven, or 24.4 per cent, gave evidence of an extension or a recurrence. Of the eleven cases, a recurrence was noted in the stump in five instances, and extensions to bones or tissues adjacent to the site of origin of the sarcoma in six instances.

7. Metastases were present in twenty-five, or 55.6 per cent, of the group of 45 cases. The highest incidence of metastases, 75 per cent, was noted among the eight cases of mixed-cell type of osteogenic sarcoma. It was found that there was an average of 1.8 metastatic foci in each case. The most frequent sites were the lungs and the inguinal, axillary, and abdominal lymph nodes. It was also noted that metastases occurred in bones in twelve instances.

8. In reviewing the diagnostic symptoms and signs of bone tumor as recorded in the histories, it was noted that those most frequently mentioned were pain and swelling, either singly or in combination, and partial or total loss of function. In nineteen instances the roentgenogram was suggestive of bone tumor. In twenty-six instances there was no record of a roentgenologic examination.

9. Of the group of thirty-eight patients with osteogenic sarcoma, amputation was the surgical procedure in twenty-eight instances, and of this number five, or 17.8 per cent, are alive. Amputation was done in all of the five cases of benign giant-cell tumor—all of the five patients are still living. Disarticulation was the surgical procedure in six cases, and of this number three are still alive. Resection of the bone was done in three instances—one of the patients is still alive. Excision of the tumor was done in three instances—two of the patients are still living. Curettement was done in six instances—three of the patients are living and three are dead.

Two patients with osteogenic sarcoma received either X-ray or radium treatment alone—both of these patients are dead.

Sixteen patients with osteogenic sarcoma received either X-ray or radium treatment, or both, in addition to undergoing a surgical operation, and of this number but two are alive. One case of benign giant-cell tumor and one case of benign osteogenic tumor received radium or X-ray therapy, or both, in addition to undergoing some surgical operation—both of these patients are alive.

Of three patients receiving treatment with Coley's toxins, two are alive and one is dead. The two cases still living also re-

ceived surgical treatment. The patient who died received Coley's toxins only.

10. The average duration of the bone tumor in the thirteen living cases has been 138.1 months, the range being from a minimum of 121 months to a maximum of 161 months.

The average duration of the bone tumor in the thirty-two patients who died was 34.2 months, the range being from a minimum of 3 months to a maximum of 113 months.

11. Of the thirty-eight cases of osteogenic sarcoma, seven, or 18.4 per cent, are alive, and 31, or 81.6 per cent, are dead. Of the group of bone tumors other than osteogenic sarcoma, seven cases in all, six, or 85.7 per cent, are alive, and one, or 14.3 per cent, is dead. Considering the group of 45 cases as a whole, thirteen, or 28.9 per cent. are alive, and 71.1 per cent are dead.

12. The thirteen living cases have survived bone tumor for the following periods: three have lived for ten years; seven have survived the condition eleven years; two have lived for twelve years, and one has lived thirteen years after the inception of bone disease.

13. The duration of bone tumor in the thirty-two cases who died was as follows: three lived less than one year; seven from one to two years; twelve from two to three years; three from three to four years; one from four to five years; one from five to six years; four from six to seven years, and one patient with unclassified sarcoma lived for nine years.

14. In nearly all instances the cause of death was either the original tumor or metastases arising from it. In several instances there was a record of a contributory cause of death from such conditions as acute myocarditis, hydropneumothorax, or chronic nephritis.

It is desired to acknowledge the assistance rendered by Anne Bambery and Orpha MacKay Allen in this study.

REFERENCES

(1) Kolodny, Anatole: Surg., Gynec. and Obst., May, 1927, XLIV (Supp. I).
(2) Geschickter, C. F., and Copeland, M. M.: Arch. Surg., July, 1930, XXI, 145.
(3) Meyerding, Henry W.: Collected Papers of the Mayo Clinic and the Mayo Foundation, 1925, XVII, 774.
(4) Geschickter, Charles F.: Synopsis of Bone Tumors and Diseases (data from forthcoming book on Bone Tumors).
(5) Bloodgood, Joseph C.: Am. Jour. Surg., 1920, XXXIV, 229.
(6) Meyerding, Henry W.: Surg., Gynec. and Obst., March, 1922, XXXIV, 321.
(7) Kolodny, Anatole: Diagnosis and Nature of Cancer (by various authors), being reprints of special articles from *Cancer Review*. John Wright & Sons, Ltd., Bristol, England.
(8) Bloodgood, Joseph C.: Ill. Med. Jour., April, 1929, LX, 251.
(9) Idem: Radiology, March, 1930, XIV, 254.

OSTEITIS FIBROSA LOCALISATA

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"OSTEITIS FIBROSA" is the term applied to the pathologic process observed in a group of bone diseases which appear at dissimilar age periods and present extremely variable clinical and roentgenologic manifestations.[1] Presenting itself in youth as a strictly localized bone cyst—benign and tending to heal after curetting—it is common enough and its clinical course well known. Paget's disease, occurring later in life, involving much of the skeleton, presenting little or no tendency to recovery, yet having a microscopic appearance similar to, if not identical with, that of a bone cyst, is also a well recognized phenomenon.

An apparently identical process limited to one bone, but involving that bone throughout its entire extent, is less commonly observed; however, some fifty cases had been collected from the literature in 1928[2] and, without doubt, many more cases have been seen but not reported.

We have had an opportunity to observe a lesion which we believe to be still less common, a process resembling that of Paget's disease, both roentgenologically and microscopically, but yet limited not only to one bone but to one area of one bone (Case 1, Figs. 1, 2, 3, 8). A biopsy was performed, establishing the pathologic nature of the lesion. It has been possible to follow the course of the disease over a period of more than two and one-half years. During that time successive X-ray examinations have shown a gradual extension along the shaft of the bone at the rate of a little less than 1 cm. a year. No bowing deformity has yet been observed and no other bones are involved, but the suggestion is certainly very strong that this case represents an early stage of a condition which will later manifest itself as Paget's disease of the entire femur, if not of other bones as well.

Case 2 represents the not uncommon form of osteitis fibrosa, occurring as a well localized lesion in a young individual, and giving rise to a roentgen appearance suggesting multilocular bone cavities. It is included in this report for comparison with Case 1, inasmuch as the microscopic sections were also made and the case was followed by roentgen examinations over a period of nearly two years.

Case 1.—The patient, a railroad conductor, aged 46, was first seen in November, 1927, with hydrops of the right knee, following a minor twist which he received in alighting from a moving train one month previously. No deformity was noted clinically (except that due to synovial effusion). He had been unaware that his knee was not normal before the minor injury mentioned. X-rays films taken at this time (Fig. 1) show, at the lower end of the femur, involving the shaft and extending down to the articular surface, a well circumscribed area of irregular rarefaction, with many coarse trabeculæ tending, in general, to be parallel with the shaft, and a slight lateral expansion of the cortex, but no destruction.

A clinical diagnosis of osteitis fibrosa was made but the possibility of some other lesion (*e.g.*, chondroma or even less benign neoplasm) was considered, and a biopsy was performed. A cortex of not abnormal appearance was encountered, beneath which was a finely lamellar structure, presenting moderate bleeding and absence of fat. The

[1] An extensive discussion of the pathology of osteitis fibrosa and of its possible relation to giant-cell tumor will be found in an article by Geschickter, C. F., Copeland, M. M., and Bloodgood, J. C.: Arch. Surg., August, 1929, XIX, 169. A brief discussion of the classification of the various clinical manifestations and roentgen variations has been published by one of us (L. H. G.), Am. Jour. Roentgenol. and Rad. Ther., December, 1929, XXII, 517.

[2] Goldstein, H. I., and Goldstein, H. Z.: Mono-osteitic Paget's disease of bones. Internat. Clin., September, 1928, III, 210.

Fig. 1 *(top)*. Case 1, Nov. 21, 1927. Roentgenogram showing an extensive area of irregular rarefaction involving the lower fourth of the right femur; the lesion involves the shaft and distal end of the femur down to the articular surface. Many coarse trabeculæ are scattered throughout the rarefied area. These tend, in general, to lie parallel to the bone shaft. There is a slight expansion of the cortex, without destruction. Films of the remainder of the skeleton are negative. *Roentgen Diagnosis:* Osteitis fibrosa localisata, hyperostotic type. *Clinical Diagnosis:* Benign lesion, osteitis fibrosa (?). *Pathologic Diagnosis:* Osteitis fibrosa.

Fig. 2 *(middle)*. Case 1, Jan. 19, 1929. Roentgenogram showing the condition fourteen months later. The lesion is a little more extensive, its limit being about 1 cm. farther up the shaft. Otherwise there is no change.

Fig. 3 *(bottom)*. Case 1, Aug. 11, 1930. Roentgenogram showing the condition nineteen months later (2 years and 9 months after Figure 1). There is a little more trabecular thickening along the cortex but no other change is noted, except that the upper limit is now about 2 cm. farther up the shaft than at the time of the first examination.

microscopic appearance is shown in Figure 8, in which the bone spicules are surrounded by dense layers of osteoblasts, the area between the spicules being occupied by the characteristic loose fibrous tissue of osteitis fibrosa. Healing of the biopsy wound was prompt, and after three weeks' rest in bed, the hydrops of the knee had completely subsided. The patient was allowed to return at first to light work and later to his regular occupation as a freight-train conductor, and has remained free from symptoms to date (three years).

X-ray films taken fourteen months after the biopsy (Fig. 2) show an extension of the process about 1 cm. farther up the shaft, and films taken two years and nine months from the date of the first observation, show an extension of about 2 cm., the extension being at the rate of a little less than 1 cm. a year. All of the films were taken with the same technic, on the same apparatus, and were checked by measurements between fixed points on the bone in each, so that we believe the estimation of the extension as stated is accurate.

Case 2.—The patient,[3] a housewife, aged 24, first noticed a swelling and soreness at the middle of the left shin, five months before admission to the hospital. There had been no pain independent of pressure over the lesion and no signs of acute inflammation; no history of injury was obtained. Her past history contained nothing of special interest and her family history was not remarkable, except that one brother died at the age of 12 of tuberculosis of the spine.

[3]Patient of Dr. Stanley Mentzer, to whom we are indebted for permission to report.

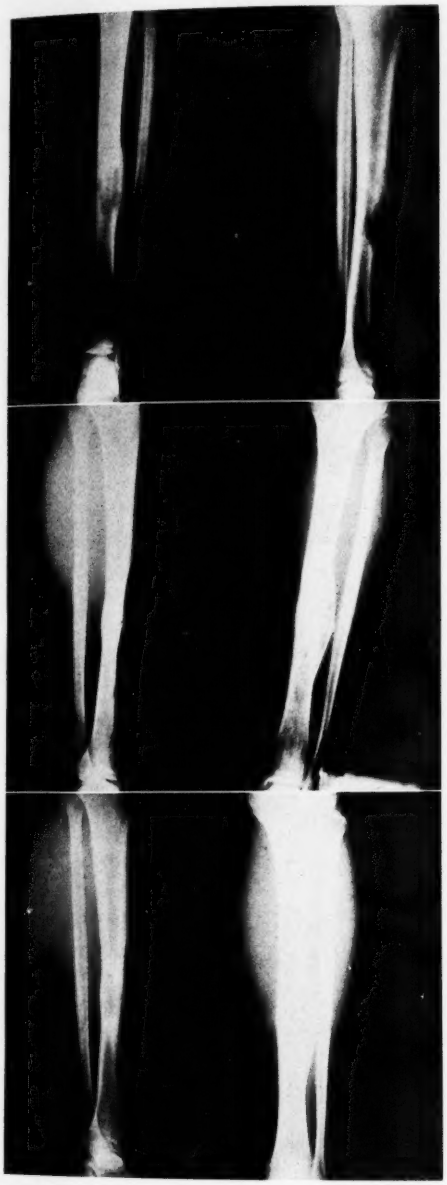


Fig. 4 *(top)*. Case 2, July 9, 1928. Roentgenogram showing an irregular "cystic" area of rarefaction, involving the shaft of the left tibia at the junction of the middle and lower thirds. There is a moderate expansion of the shaft anteriorly and laterally but no destruction of the cortex. The bony trabeculæ, proximal to the main portion of the lesion, are coarser than normal. *Roentgen Diagnosis:* Osteitis fibrosa localisata, probably porotic type. *Clinical Diagnosis:* Benign lesion—bone cyst. *Pathologic Diagnosis:* Osteitis fibrosa.

Fig. 5 *(middle)*. Case 2, May 24, 1929. Films taken approximately eight months after the operation. There is a post-operative defect along the anterior third of the bone; the tibia is apparently about 5 mm. wider than in the first film. There is a linear area of rarefaction across the middle of the lesion—umbauende zone (?).

Fig. 7. Case 2, Dec. 15, 1930. Roentgenogram showing condition thirteen months later. There is a further filling in of the operative defect, with restoration of the normal contour of the tibia. No further extension of the lesion. Note the absence of expansion anteriorly, seen in the first film.

The general physical examination disclosed nothing of note, except large chronically infected tonsils. At about the mid-point of the anterior surface of the left tibia there was a large, hard protuberance, 3×4 cm. in extent, the surface smooth and the outline shading off gradually to the normal bone surface. The Wassermann reaction was negative.

The X-ray films taken at this time are shown in Figure 4. The lamellæ of increased density, paralleling the shaft of the bone (cf. Case 1), are also evident here, but to a less degree, and, in addition, there is seen the usual appearance presented by osteitis fibrosa in youth—the formation of cavity-like areas (cysts) in the bone.

Captions continued

Fig. 6 *(bottom)*. Case 2, Nov. 6, 1929. Roentgenogram showing the condition six months later. There is a filling in of the operative defect anteriorly, and possibly a slight diminution of the width of the tibia at the level of the center of the lesion. Note the apparent recalcification of the most laterally placed rarefied area.

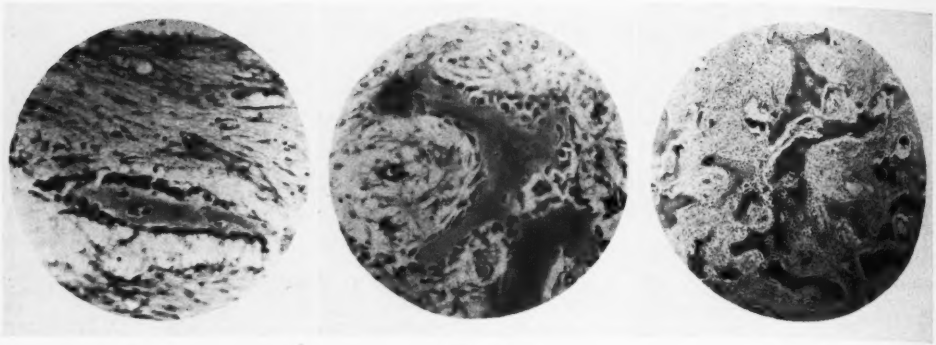


Fig. 8. Fig. 9. Fig. 10.

Fig. 8. Case 1. Photomicrograph of a section of the material from the biopsy (high power). The loose osteitis fibrosa tissue is also shown. A spicule of new bone is surrounded by a closely packed layer of osteoblasts.

Fig. 9. Case 2. Photomicrograph of a section of the material removed at operation (high power). The picture is essentially the same as that shown in Fig. 8, Case 1.

Fig. 10. Case 2. Photomicrograph (low-power view) of the same section as shown in Figure 9.

At operation, Sept. 10, 1928, no true bone cavity or cyst was found. Under an eburnated cortex, there was a firm lamellar structure, with absence of fat between the bone spicules. The cortex over the entire area of the lesion was chiselled off and curettage performed down to what appeared to be normal bone. The wound healed gradually, some drainage persisting for six months, and since then it has remained healed.

Eight months after the operation (May, 1929), films taken of the leg (Fig. 5) showed the post-operative defect in the tibia, with slight widening of the bone but no extension of the process along the shaft. There is a linear area of rarefaction, with fairly dense margins running incompletely across the middle of the former cystic area. This presumably represents an "umbauende" zone, as described by Looser and recently discussed by Salinger.[4] Subsequent examinations of the leg (6 and 19 months later, Figs. 5 and 6) showed filling in of the operative defect, no evidence of further extension of the lesion, and a questionable degree of increased density along the mesial side of the bone—recalcification (?).

SUMMARY

A case is reported of a lesion limited to the lower end of the femur in a man of 46, presenting an X-ray appearance suggestive of Paget's disease, with the microscopic pathology of osteitis fibrosa. Subsequent roentgenograms showed the lesion to be extending at the rate of a little less than 1 cm. a year. The suggestion is offered that this is an early stage of what will later appear to be a so-called Paget's disease, involving the entire bone.

[4]Salinger, H.: Ueber Loosersche Umbauzonen mit besonderer Berücksichtigung ihres Vorkommens bei Osteodystrophia Fibrosa. Fortschr. a. d. Geb. d. Röntgenstr., June, 1929, XXXIX, 1049.

BONE CYSTS

By ALEXANDER R. COLVIN, M.D., St. Paul, Minnesota

IN the differential diagnosis of the pathologic conditions affecting organs or tissues, there is often one condition around which center most of the difficulties of the problem. In the mammary gland, cystic mastitis or fibro-epithelial degeneration, because of its clinical varieties and unknown possibilities, seems to occupy this position. In bone, osteitis fibrosa, occupying a midposition between neoplasm and inflammation, causes, at times, a good deal of confusion. Because of the frequent presence of cyst formation in this disease, perhaps the subject of bone cyst formation has been associated more often in our minds with osteitis fibrosa than with any other one pathologic condition of bone. It is important, however, to remember when we are facing the problem of differential diagnosis the various conditions of bone in which cyst formation occurs.

(1) As degeneration product of a solid tumor,

(2) As a parasitic cyst,

(3) As the end-product of an infectious osteomyelitis,

(4) As the product of rarefying process in bone, *e.g.*, arthritis deformans, in osteoporosis, and in osteomalacia,

(5) Rickets,

(6) Callus cysts,

(7) Osteitis fibrosa.

After a consideration of all of these causes of bone cyst, there remains the genuine simple bone cyst, which, perhaps, has nothing to do with any of the conditions named. This simple cyst is found most frequently in youth; is usually a single cavity, although at times divided by septa; has a smooth wall provided with a definite limiting membrane, and contains a yellowish, slimy, and occasionally a blood-tinged fluid. It is most frequently found in the metaphyseal region of the shaft of the long bones. A cyst conforming to this description is always a benign lesion.

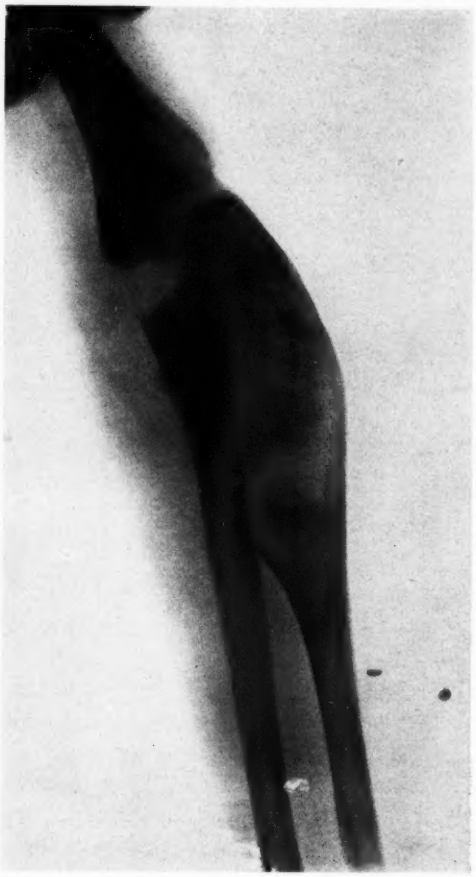
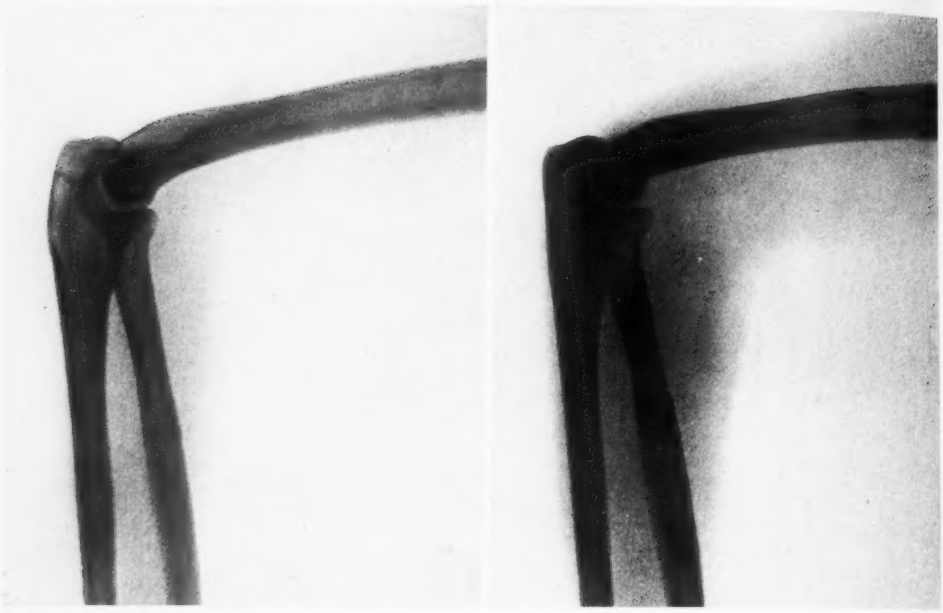


Fig. 1. Roentgenogram of a bone cyst in the upper end of the ulna in a girl 5 years of age, following an injury (Path. No. 9,025).

The following case, seen clinically over a period of twenty-five years, can fairly be classified as a genuine simple bone cyst. The patient, a girl of 5 years, gave a history of injury, with an immediate swelling which gradually increased in size. This history, however, could be interpreted in



Figs. 2-*A* and 2-*B*. Roentgenogram of the same lesion twenty-five years later. Figure 2-*A* shows the healed lesion and Figure 2-*B* shows the normal unaffected arm for comparison.

two ways, either as an etiologic factor, or—and this seemed more likely—an injury to an existing condition. She presented a swelling of the upper end of the ulna, which was neither painful nor tender. Pressure over this area resulted in a parchment crackling, characteristic of bodies with thin, more or less elastic walls, such as is felt most clearly on indenting a tennis ball. When this was first seen it presented an appearance as shown in Figure 1. For a time there was a steady increase in size and then a gradual decrease, extending over a period of years, until, at the present writing, there is a barely perceptib'e difference in the ulna of the two forearms. The radiograph, however, reveals that the bone at the site of the cyst is still very slightly larger than the opposite one (Figs. 2-*A* and 2-*B*), the trabecular markings somewhat coarser, and an area about the size of a small pea, which resembles a small cavity, is seen.

Tietze, after his review of our knowledge of bone cysts in *Ergebnisse der Chirurgie und Orthopädie*, in 1911, states that we can easier say all that a bone cyst is *not*, than we can say what its significance really is.

The observation of the outcome of this case confirms, as to its character, in a very positive manner, the opinions expressed years ago; for instance, Mikulicz said, in 1904, that it was always a benign process, basing this opinion upon the fact that it never metastasized and that after spontaneous fracture, which frequently occurs in bone cysts, callus formation and consolidation always take place. The writer can confirm this observation from several experiences. The disappearance of the cyst being reported, of course, confirms in positive manner of Mikulicz's opinion.

The somewhat rapid evolution of the process in this case would, of course, seem to exclude all of the causes given for the formation of cysts in bone. It is, for in-

stance, unlikely that any tumor which has attained a certain size at the age of five, would grow and degenerate and begin to heal and disappear within a few years as this one did. For the same reason, osteitis fibrosa could not have anything to do with this genuine simple cyst.

In osteitis fibrosa the cysts, when present, are not the dominating features of the disease, but are, as it were, a by-product of the disease. The description of the clinical pathology of osteitis reads and looks more like a combination of inflammation and tumor formation than it does a primary cystic disease.

Inasmuch as the only study of the case which is the subject of this report was clinical and radiographic, nothing can really be added to our knowledge of the subject, except that a simple bone cyst in a child can in time spontaneously disappear and remain cured over a period of twenty-five years. Surgery was refused in this case by the parents, and, in consequence, the observations referred to were possible. Inasmuch as the case was almost symptomless, the enlargement in the contour of the bone was the first thing to be noticed; the physical signs were also characteristic—*i.e.*, the egg-shaped enlargement and the crackling indentability. When the case first came under consideration the differential diagnosis from the various lesions enumerated in which cystic formation is only a part of the clinical pathology, seemed a matter of course.

The only other condition which I have seen in which the physical signs were the same, was cyst formation in the upper and lower jaw, one a follicular cyst and the other an adamantinoma, with cyst formation. The latter case well illustrates the necessity of studying the surrounding tissues in the operative exploration or treatment of bone cysts, for the recurrence of the cyst after operation in the adamantinoma case led finally to the finding of the tumor tissue in the case of the cyst formation.

It is, of course, questionable whether or not the course pursued in this cyst of the ulna is often justifiable for the reason that radiographic study, while often convincing, is not always so. It must be emphasized that in the radiographic study it is necessary to view the radiograph with the mind actually considering the possible surgical pathology in each case, and even when this is done, it is perhaps easier to say from the radiograph that we are *not* dealing with a simple bone cyst than to say that we *are* dealing with one. The radiograph at least will enable us to reduce the number of possibilities, and the typical shape, the thinned-out cortical bone, and the absence of periosteal thickening will enable us to express an opinion of great probability. The form is not always regular in enchondroma and sarcoma, the latter perforating the bone comparatively early, but in giant-cell tumors it may never perforate.

In bone abscess, the encapsulating bone is dense and thickened; this is also true of bone gumma. The isolated masses of osteitis fibrosa are not always to be differentiated, and surgical exploration is usually necessary to establish a diagnosis. On exploration, the thin walls of the cyst, with the clear lining membrane and the comparatively clear fluid, will be quite evident. If one will keep in mind the number and variety of conditions in which bone cysts, in the broad sense, are found, and on exploration will note the character of the surrounding tissue, and, lastly, the microscopic character of the tissue, a diagnosis of the condition causing the cyst can usually be made.

For a wide and enlightening study of these various conditions, the work of Joseph C. Bloodgood, as given in his article on "Benign Bone Cysts, Osteitis Fibrosa, Giant-cell Sarcoma, and Bone Aneurysm of the Long Pipe Bones," in *Annals of Sur-*

gery, August, 1910, LII, 145, and the review of Alexander Tietze in *Ergebnisse der Chirurgie und Orthopädie,* 1911, II, 32, are worth while reading.

The Requirements of the Clinician from the Radiologist and *Vice Versa*. G. B. Batten. British Jour. Radiol., June, 1930, III, No. 30, p. 259.

The author believes that the requirements, in general, of clinicians from radiologists should be the same as from all other specialists, and, conversely, the radiologist may ask of the clinician any information which may help to elucidate the problem necessary for a correct diagnosis. Naturally, such pertinent information might be quite different from that needed by the bacteriologist or any other medical consultant. Only rarely is a clinical consultation requested and all information withheld for the good of the patient, and, similarly, in the best interests of the patient, such cases sent for roentgenological consultation must be equally infrequent.

The author explains the situation of the radiological personnel of England, there being the pure roentgen specialists in London and larger hospital towns, but also a large group in the suburbs and small towns of general practitioner radiologists. The relations between the latter group and the clinician group are distinctly more difficult, and the most ethical dealings with both patients and clinical colleagues are necessary in such instances. The tendency of many younger clinicians to refer cases immediately for roentgen study before utilizing the simple means of physical examination is deplored, and every case should have something of a provisional diagnosis made before the X-ray study is attempted. The roentgenologist should then, for his part, report his conclusions, together with all findings upon which such conclusions are based, in every case attempting to avoid the vague without being too dogmatic.

J. E. Habbe, M.D.

THE TREATMENT OF ADVANCED CANCER OF THE BREAST

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FOR the purposes of definition in this discussion, advanced cancer of the breast is to be thought of as cancer which, because of its local or general development, has reached such a state as to offer no reasonable hope of cure. Treatment of such cancer thus becomes a question of palliation. In undertaking palliative treatment, however, we should consider very earnestly the best means of obtaining that end. The ideal, of course, is to procure the greatest possible comfort and sense of well-being to the individual for the greatest possible length of time. There is always the urge to "do something," but unless that urge is translated into well considered action, we may be chagrined to find that the state produced is worse than that which we have attempted to relieve. The effort may not give relief commensurate with the discomfort incident to the measures carried out.

It is obvious that few rules can be formulated which are applicable to all or even most of the cases. In certain cases, pathologic grading, suggested by Broders (1), and applied to mammary cancer by Greenough (2), and clinical grading introduced by Lee and Stubenbord (3), may be useful. The individual case, however, is largely an individual problem which must be considered from many angles. The mental and emotional qualities of the patient, for example, should enter into the appraisal. External ulceration may be abhorrent to one patient while another may be concerned almost entirely with painful manifestations of the disease. In general, the plan of treatment must depend upon the actual physical state and upon the patient's reaction to that condition. Treatment will, further, be determined by the therapeutic agencies available and by the efficiency to be expected in their application.

Fig. 1. Case 1 (August 15, 1928). Appearance before operation, showing extensive ulceration, with destruction of the nipple.

Erythema.—Erythema of the skin, overlying the tumor and spreading beyond its borders, is a bad prognostic sign. It usually means that diffusion has occurred and that carcinomatous thrombi occupy the subcutaneous venules and lymph spaces. Remote metastases are very probable. If these are not in evidence, radical mastectomy, with wide excision of skin, offers a remote but the only chance of cure. If not done, ulceration is likely to occur before the patient succumbs to other manifestations of

Fig. 2. Case 1 (June 25, 1929). Appearance ten months after radical mastectomy, with skin graft. Considerable pigmentation from post-operative X-ray treatment is present, but there is no local recurrence.

the disease, especially if intensive radiation is applied. In the presence of grave internal metastases, radiation alone is better, but if the skin is involved the danger of producing ulceration must not be overlooked. In a moderate number of cases, especially in elderly patients, if properly conducted, it may be depended upon to hold local progress in check until death occurs.

Ulceration.—Ulceration, if at all extensive, is, to the majority of patients afflicted with cancer of the breast, a most distressing symptom. Serious efforts should be made to prevent or to remedy it. Ulceration *per se* does not necessarily mean that the disease is hopeless. Bloodgood is fond of showing photographs of cases to his students and asking for a prognosis. They are astonished to learn that certain patients with ulceration have lived in health for many years after radical mastectomy. In general, however, when cancer of the breast has reached the stage of ulceration, inaccessible metastases have already occurred and the treatment must be palliative. If the ulcer is simple, if the growth is not directly attached to the ribs, and if internal metastases are not demonstrable, radical mastectomy is the most satisfactory palliative procedure. It puts an end to ulceration with its depressing features and there is always the chance of a cure. It also permits effective palliative radiation. In the presence of extensive internal metastases, simple mastectomy may be preferable.

Skin Metastases.—Skin nodules may be present when the patient is first observed, but are more often encountered as post-operative recurrences. They are frequently seen adjacent to the scar, and sometimes indicate insufficient inclusion of skin at the time of operation. They occur quite commonly, however, at points relatively remote from the line of excision in the late stages of the disease, and are not often seen in the axillary skin, except in very advanced cases. This fact casts some doubt on the value of routine excision of the axillary skin, as advocated by Jennings (4). Among the most frequent points of local recurrence are the intercostal spaces at the sternal margin. These tumors are nearly always fixed and often are small external manifestations of large subcostal and substernal masses. When recurrent skin nodules present themselves singly or in a small group, excision with skin graft sometimes affords a long period of remission. Frequently, however, the solitary nodule is the herald of widespread local recurrence eventuating in the formation of carcinoma *en cuirasse.*

Generally speaking, radiation is preferable in controlling skin nodules. They may often be held in check over long periods of

time and frequently may be made to disappear altogether.

Fixation to the Chest Wall.—Primary carcinoma of the breast, with definite fixation to the ribs or to the intercostal muscles, has become a fairly rare condition. It is occasionally seen in patients of backward mentality, in certain persons who do not admit the existence of physical disease, and in cases in which mistreatment has been carried out, either by frank charlatans or by members of the medical profession. This complication is one of the most difficult to manage; operative treatment is out of the question. Radiation may retard the growth, especially if the patient is elderly, but unless carried out by persons well trained in radiotherapy, it may cause sloughing and open ulceration. In exceptional cases, it is better not to disturb such a growth. I have observed such a case in a woman 80 years of age, in which the progress of the disease, over a period of two years, was negligible. The patient suffered no discomfort from this lesion, except occasional itching of the overlying skin, and eventually died of cardiorenal disease. Isolated post-operative recurrences in the chest wall occasionally may be treated to advantage by surgery. Semken (5) has shown two cases remaining well many years after the removal of a segment of the chest wall, with repair by sliding grafts.

Axillary Metastases. — Occasionally we see cases in which axillary involvement is the most pronounced manifestation of mammary cancer. This complication may be one of the most dreadful. Pressure on the nerves of the brachial plexus gives rise to excruciating and continual pain. Few conditions are more distressing. When at all possible, surgical removal should be attempted, even if it involves sacrificing the axillary vein. I have seen no harmful results from resection of a portion of this vein (see Fig. 6). When it is found impossible to remove absolutely all of the gross tumor, a partial removal will be advantageous for subsequent radiation. Bloodgood (6) has reported a case in which he was unable to completely remove an axillary recurrence. The incomplete operation was followed by X-ray treatment, the patient remaining well at the end of five years.

Fig. 3. Case 2 (September 11, 1930). Photograph showing the site of local removal of carcinomatous tumor one year previously. The recurrent tumor is seen beneath the scar.

Supraclavicular Metastases.—Routine removal of the supraclavicular lymph nodes has long ceased to be considered necessary. Occasionally, however, metastasis is seen in this region. Unless associated with other metastases, which are likely to be rapidly fatal, carcinoma in the supraclavicular nodes should be extirpated surgically whenever possible. A case of my own remained

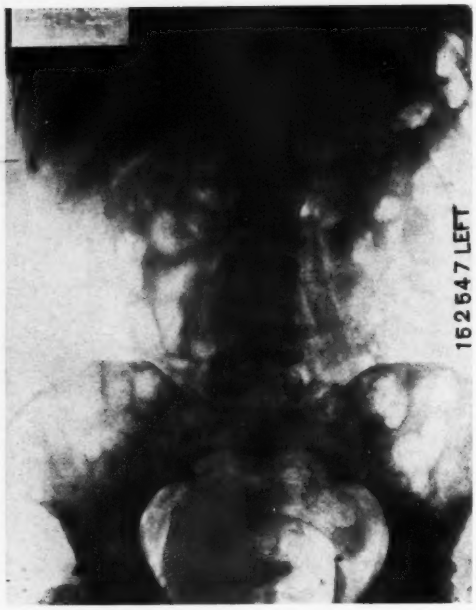

Fig. 4. Case 2 (October 9, 1930). Roentgenogram showing extensive involvement of the lumbar spine and pelvis. The patient was walking and free from symptoms after two months of intensive X-ray therapy.

well for more than two years after operation for metastasis in the supraclavicular nodes. At the time of operation, it was possible only with the greatest difficulty to separate the nodes from the subclavian vein. X-ray treatment of supraclavicular metastases is not always satisfactory, because of scar formation involving the brachial plexus. In elderly patients, however, radiation is perhaps preferable to surgery.

Thoracic Metastases.—These are seen most often as post-operative recurrences, but may appear before the local breast tumor seems far advanced. When the mediastinal nodes become extensively involved, partial tracheal obstruction may supervene to harass the patient. Radiation in such cases is seldom beneficial for more than a few months and is attended with some danger. Sufficient additional swelling may rarely be brought about to produce complete obstruction. In cases of pleural metastases, however, considerable relief may be obtained by radiation. It is often effective in controlling pain and in diminishing the tendency toward pleural effusion. When effusion actually exists, aspiration, repeated as often as necessary, affords great relief. Handley (7) has advocated the parasternal implantation of radium as a means of preventing mediastinal metastases, but the value of the procedure seems doubtful.

Abdominal Metastases.—Peritoneal invasion, with the production of ascites, is perhaps the most common abdominal manifestation of metastatic carcinoma of the breast. Involvement of the liver, according to McWhorter and Cloud (8), occurs more often than involvement of the lungs, the figures given being 34 and 22 per cent, respectively. When it does occur it is late in producing symptoms, and much depends upon the exact location of the nodules. Carcinomatous tumors of the ovary, appearing secondary to breast cancer, as a sort of Krukenberg tumor, have been rarely observed. They usually give little in the way of early symptoms and are most often discovered after abdominal metastases have become general. Against such we are practically helpless. Radiation is sometimes effective but frequently fails to retard the disease to an appreciable extent. If high dosage is attempted, nausea and prostration may cause discomfort out of proportion to the relief obtained.

Repeated tapping is very helpful in relieving the distress incident to the accumulation of ascitic fluid. The danger of perforating the intestines with the trocar is less than it would seem, even when there are palpable intra-abdominal carcinomatous masses.

Bone Metastases.—Except for direct extension to the ribs, Carnett and Howell (9) give the order of frequency of bone metastases in breast cancer as: homolateral shoulder girdle, third to sixth thoracic verte-

bra, upper lumbar vertebræ, the pelvic bones, and the lower cervical vertebræ. This order is somewhat at variance with that given by Lenz and Freid (10), arrived at by a slightly different method of observation. The patient may be made helpless by bone destruction, pathologic fracture at any important site, or by pain. Destruction of the vertebral bodies, with resulting deformity and pressure on nerve roots, may cause incessant and excruciating pain. Involvement of the skull may be extreme without the production of notable symptoms.

In metastases to bone, radiotherapy frequently gives most gratifying results. Some cases show at least temporary arrest of the process, and certain others show definite regression of the disease. Another group of cases experiences partial or complete relief from pain, even though repeated radiographs show no improvement as to the progress of the disease (see Case 2, Figs. 3, 4, and 5). Pathologic fractures sometimes heal spontaneously (11) and sometimes with radiation, if not too heavily radiated.

Metastases to the Central Nervous System.—According to Lenz and Freid (10), this complication occurs in about one-fifth of the late cases. Sixty-eight of the cases diagnosed as spinal cord involvement had corresponding skull and vertebral metastases. This suggests that epidural metastatic growths, rather than actual implantations in the central nervous system, may be responsible for most of the central neurological symptoms. In some of the spinal cord cases, radiation is effective in the relief of pain, and occasionally it retards growth to some extent. Radiation of the skull, however, is generally unsatisfactory. It brings little relief and patients object to having the hair fall out.

ILLUSTRATIVE CASES

Case 1 (68,047).—A female, white, sixty-four years of age, was admitted to St. Luke's Hospital, August 14, 1928.

Fig. 5. Case 2 (November 13, 1930). Roentgenogram showing involvement of the skull. At this time the patient had no headache or other symptoms referable to the central nervous system. No radiation has been given to the skull.

History.—A lump in the right breast was first observed two and one-half years previously, and was permitted to grow undisturbed until six months before admission, when the odor from an ulceration attracted the attention of the patient's sister.

Examination.—An area of ulceration, 9 cm. in diameter, surrounds and includes the nipple area. Underlying the ulcer is a hard, irregular mass about 20 cm. in diameter. The right axillary lymph nodes are large and hard.

Operation.—On August 17, 1928, under colonic ether anesthesia, a radical mastectomy, with a Thiersch skin graft, was performed, including a wide area of skin beyond the ulcer.

Pathological Report.—Diffuse, cellular carcinoma of the breast and axillary lymph nodes.

Result.—A few small skin nodules appeared ten months after the operation. These disappeared under X-ray therapy

Fig. 6 (November 22, 1928). This patient was operated upon March 9, 1927, for cancer of the breast, with extensive axillary node involvement. At the time of operation it was necessary to resect a portion of the axillary vein in order to remove all of the gross metastatic tumor. No more than the usual swelling resulted and there was no circulatory disturbance.

The patient lived without subjective symptoms until March 13, 1930 (nineteen months), when she died suddenly, the cause of death being unknown; no autopsy was performed.

Case 2 (83,059). — A female, white, forty-eight years of age, was admitted to St. Luke's Hospital, September 8, 1930.

History.—An incomplete operation for carcinoma of the upper outer quadrant of the breast was performed one year previously in another hospital, with a local recurrence three months later. The patient complained of excruciating pain in the left hip, radiating down the left thigh, for four months, and, with her strength gradually failing, she is now practically bed-fast.

Examination.—The patient's complexion is pasty, and she appears ill. There is a hard mass about 6 cm. in diameter underlying the scar at the site of operation. It is fixed to the skin and to the chest wall. The right axillary nodes are large and hard, but not fixed. Marked tenderness is present in the left gluteal region and along the posterior surface of the left thigh.

X-ray Reports.—There is extensive bone involvement of the lumbar spine and left ilium. The first and second lumbar vertebræ show extensive destruction (September 9, 1930).

There is a pathologic fracture of the left clavicle at the junction of the middle and outer third (October 9, 1930).

The condition of the spine and pelvis is unchanged. Foci of involvement are seen in the left humerus, left radius and ulna, and in the upper thirds of both femurs. The skull (Fig. 5) shows marked invasion (November 13, 1930).

Treatment.—The patient received intensive deep X-ray therapy under the supervision of Dr. Francis Carter Wood, from September 12, 1930, to the present time.

Result.—She was able to leave the hospital on December 10, 1930, walking without difficulty and free from pain. When last seen, January 11, 1931, she was still practically free from symptoms. However, there were many large, fixed nodules in her scalp.

SUMMARY

The treatment of hopeless cancer of the breast is in any case a discouraging task. It is one, however, which should not be evaded. The morale of the patient is much more likely to be preserved if she does not feel that she is being deserted by her physician. Much can be done to encourage the sufferer and to alleviate discomfort.

Surgery and radiation constitute practically our whole equipment in actually combating the disease. With the marked progress in radiotherapy, there has been a tendency to overlook the value of surgery. It has a definite place in the palliative treatment as well as in the cure of cancer. Jackson and Minot (12) have pointed out

many ways in which purely medical treatment may add to the comfort and general wellbeing of the cancer patient.

REFERENCES

(1) Broders, Albert C.: Jour. Am. Med. Assn., March 6, 1920, LXXIV, 656.
Idem: Ann. Surg., February, 1921, LXXIII, 141.
Idem: Minnesota Med., November, 1925, VIII, 726.

(2) Greenough, Robert B.: Jour. Cancer Research, December, 1925, IX, 453.

(3) Lee, B. J., and Stubenbord, J. G.: Surg., Gynec. and Obst., December, 1928, XLVII, 812.

(4) Jennings, John E.: Surg. Clinics North America, August, 1927, VII, 895.

(5) Semken, George H.: Ann. Surg., March, 1924, LXXIX, 461.

(6) Bloodgood, Joseph C.: Radiology, March, 1924, II, 162 (see p. 163).

(7) Handley, W. Sampson: Report of International Conference on Cancer (London), July 17-20, 1928, p. 139.

(8) McWhorter, John E., and Cloud, Albert W.: Ann. Surg., September, 1930, XCII, 434.

(9) Carnett, J. B., and Howell, J. C.: Ann. Surg., June, 1930, XCI, 811.

(10) Lenz, Maurice, and Freid, Jacob R.: Ann. Surg., January, 1931, XCIII, 278.

(11) Neuhof, Harold: Quoted by Lenz, Maurice, and Freid, Jacob R. (10).

(12) Jackson, Henry, Jr., and Minot, George R.: Am. Jour. Cancer, January, 1931, XV, 6.

PAGET'S DISEASE OF THE BONE

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PAGET'S osteitis deformans is usually described as a "chronic, slowly progressive disease involving one or more bones of the body and causing certain structural changes which result in an increase of size and thickness." When the diseased bone happens to be the tibia or femur, changes in contour, curvatures, and pathologic fractures are not infrequent. As a basis for this discussion of some of the clinical aspects of this disease, I shall briefly report three such cases.

Case 1. P. W., a male, aged 52, was admitted to the Harrisburg Hospital September 15, 1924, with fracture of the right leg. While playing tennis he felt a "snap" in the leg, following which there was not much pain, but he was unable to walk. The X-ray films showed a fracture of the upper third of the right tibia, the parts in good position. The films also showed a cystic condition of the upper two-thirds of the tibia, with much thickening and bone proliferation, and arching and bowing of the tibia. The X-ray diagnosis was pathologic fracture and Paget's disease. No other bones were involved.

There had been a gradual increase in the size of this leg, associated with some pain, for four years prior to the fracture. Otherwise the man's general health was excellent. The Wassermann was negative.

About three months after the accident the patient was referred to Dr. Bloodgood for an opinion as to subsequent management, because of the delayed union, probable nonunion, and possible malignancy. Dr. Bloodgood showed films of this case during one of his morning sessions, and told his hearers why he advised amputation of the leg.

Paget, in his original paper, noted the association of bone malignancy with osteitis deformans. Codman, in his recent investigation of bone tumors, found that 14 per cent of all cases of Paget's disease die of osteogenic sarcoma. A still more recent report from the Bone Registry of the American College of Surgeons says that 5 per cent of osseous sarcomas begin in bones involved in the type of pathology under discussion. If we are to believe these statistical reports, the occurrence of bone sarcoma in cases of osteitis deformans is more than a coincidence.

Case 2. G. T., a male, aged 52, was admitted to the Harrisburg Hospital February 9, 1929, with a history of a fall down several steps and an injury to the right hip. X-ray films showed an oblique fracture of the upper end of the shaft of the femur, with shortening and poor approximation of the fragments. The femur above and below the fracture had the mottled cystic appearance of Paget's. No other bones were involved, and the Wassermann was negative. There had been no previous symptoms except pain in the right knee for several months before the accident. The patient was treated as though his was an ordinary fracture, union took place, with much callus, in three months. The man walked with a cane in eight months, and is apparently well at the present time.

Case 3. C. A., a male, aged 59, was admitted to the Harrisburg Hospital, March 2, 1929, with pathologic fracture of the left leg. He had twisted his leg while opening a door. The X-ray examination showed a transverse fracture one inch below the inner trochanter, outward bowing of the femur, and increased thickening and density of the upper two-thirds of the femur. There was no X-ray evidence of Paget's in the right femur, the skull, or the vertebræ. For a year the patient had noticed an outward bowing of the femur, and pain in the left knee. Excessive callus accompanied union in the

Fig. 1. Pathognomonic cranial bone changes in Paget's disease. Note the thick finely porous outer table, covered by small bony nodules. (X-ray examination by Dr. Ritzman.)

bone in six months, and the man walked in twelve months.

The diagnosis of Paget's in these three cases was made from the X-ray films after fractures following slight injuries. Like all patients with this disease, there was an absence of definite characteristic symptoms in the early stages. Pain was the one common symptom, because the lesions happened to be in the extremities. In this early stage there is no diagnostic clinical picture. Physical examination may show no cause for the complaints, and months may pass before the X-ray examination shows bone changes. Some cases are free from all subjective symptoms and note only the slow, gradual increase in size of the bone. This explains why an early positive diagnosis is difficult, and often not made at all. In the cases reported, there were no secondary anemias and the Wassermanns were negative. The relationship of syphilis and osteitis deformans has been a freely discussed question, and it is generally believed their association is incidental and in no way related. There was no blood chemistry done in these cases. In a recent review of twenty-one cases this phase was discussed by Bortz, of Philadelphia, and he was not able to demonstrate any constant findings.

The clinical diagnosis is comparatively

Fig. 2. The irregular thickening of the long bones in Paget's disease. Note the anterior bowing and multiple bone cysts. (X-ray examination by Dr. Ritzman.)

easy when there is cranial and multiple bone involvement, with the classical structural changes of the later stages. These changes in the skull are pathognomonic and familiar to all—the gradual general enlargement, undue prominence of the frontal bones, and non-involvement of the face. The bone is several times normal thickness, without encroaching upon the skull cavity. There is a finely porous outer table (area of rarefac-

tion) covered with small nodules of bone. This X-ray appearance has been likened to the "kinky hair of the negro." No other bone lesion produces this picture.

The long bones in Paget's disease are large, thick, rough, irregular, with anterior or lateral bowing, and contain many multiple cysts from bone absorption. When the vertebræ are involved there is anterior bowing of the spine as a result of these same bone changes.

The following theories have been advanced as to etiology: (1) A chronic irritative process within the bone (toxic infection); (2) a defective calcium metabolism (parathyroid dysfunction); (3) heredity. None of these is satisfactory and none is of more than merely academic interest.

A Roentgenologic Study of the Breast. Stafford L. Warren. Am. Jour. Roentgenol. and Rad. Ther., August, 1930, XXIV, 113.

As the title indicates, this paper is primarily a roentgen study of the normal and pathological breast. The author describes a simple standardized technic which he believes will be absolutely diagnostic in some types of cases and of considerable assistance in others. The technical factors recommended are: 185 milliampere-seconds, 25 inch target-film distance, Potter-Bucky diaphragm, double screens, and from 50 to 60 kilovolts. The opposite side is always taken for a comparative study, and each side is studied stereoscopically.

The author describes and gives illustrative roentgenograms of the normal breast, changes due to pregnancy, breast abscess, chronic mastitis, benign and malignant tumors. The normal breast usually has from 5 to 8 ducts, extending from the nipple region downward to the base. The breast lobules stand out from the fatty masses, which are relatively transparent. The base of the breast is sharply separated from the pectoralis muscles by a definite line or septum. Breast abscess shows a uniformly dense localized mass, together with a generalized haziness, indicating the associated generalized inflammatory process. Benign tumors are clearly demarcated from the surrounding tissues and are usually of homogeneous density. In malignant tumors there is a dense sheet or mass, with irregular edges and feathery strands of dense tissue invading the ducts and lobules, with puckering and distortion of these normal structures.

The comparative accuracy of the cases studied by the author is shown by a tabulation in which 119 cases diagnosed by X-ray films were correct and only 8 cases incorrect; 45 cases were proved by operation or autopsy. On the basis of the studies made, the author concludes that: *(a)* stereoscopic roentgenographic study of the normal breast, whether obese or atrophic, conforms to the anatomical structures which are present; *(b)* abnormalities, visible in such films, also correspond very closely to the gross appearance of such abnormalities; *(c)* the diagnosis from the films of the breast corresponds very closely to the operative and autopsy findings.

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THERAPY WITH LONG WAVE LENGTH X-RAYS (GRENZ RAYS)[1]

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NEW YORK

IT has long been known that the commercial X-ray tube emits practically no X-rays when run at a voltage of 10 kilovolts or less. The reason for this is that the glass of which the tubes are made has a high absorptive power for the long wave length X-rays. If 10 kilovolts is taken as the limiting value for the voltage, the shortest wave length of the X-rays which are excited is given by the well known Duane formula, which is: The shortest wave length in Ångström units equals 12.35 divided by the peak voltage in kilovolts. This value is obviously 1.235 Ångströms. Longer wave lengths than this are retained by the glass.

Many years ago, Lindemann showed that if a lithium borate glass was used, and the thickness kept low, X-rays of considerably longer wave length would escape from the tube than with ordinary glass. As the lithium glass is difficult to handle, it is usual to make the tube of ordinary glass and insert a small window of lithium glass opposite the anticathode, though Bucky has designed a tube wholly composed of lithium borate glass. The construction of such tubes does not vary in principle from that of ordinary tubes. The anticathode is made of tungsten or an iron-chromium alloy and the electron stream is derived from a hot cathode as in the usual Coolidge construction. Water cooling of the anticathode is usual, as it greatly increases the tube output. Under these circumstances, radiation from 1 to 3 Ångströms appears in quantity outside the X-ray tube, though probably at least 50 per cent is absorbed even in the lithium glass window. The lithium glass is not absolutely essential. If the wall of the tube is kept thin enough, such long wave length X-rays as mentioned will penetrate in large quantities, but tubes with thin glass windows are difficult to handle from the mechanical aspect. X-rays of the longer wave lengths are rapidly absorbed in the air. Of those of 2 Ångströms, 20 per cent is absorbed in a 10 cm. thickness of air, the corresponding absorption for 3 Ångströms being 40 per cent. It is necessary, therefore, in practice, to make accurate measurements of the skin-focus distance, and it may even be advisable to filter the radiation with very thin aluminum foil, properly supported, in order to get a little more homogeneous radiation. It is obvious that if 20 per cent of the shorter wave lengths is absorbed in 10 cm. of air, the absorption in the skin will be much higher. As a matter of fact, the radiation of 3 Å.U. loses half its value in penetrating at a maximum 0.2 mm. of the skin, while that of 2 Å.U. loses half its value at approximately 1 mm. below the skin surface. This does not mean that a certain amount of the shorter wave lengths will not have a considerable range, and this is shown by the fact that it is possible to take excellent pictures of the bones of the hand with such radiation. Also the grain structure of a piece of pine wood 2.5 cm. thick is well brought out by a short exposure with such a tube, giving much more detail than is ordinarily obtained with higher voltages.

The clinical measurement of these long rays can be carried out either by the use of the Sabouraud pastille, with the inaccuracies incident in such determinations, or by a specially constructed ionization chamber of the thimble type. The chief point is that the walls of the chamber be thin enough so that the radiation is not largely absorbed before it reaches the air of the chamber. In well equipped laboratories the measurements can

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be made, of course, with an open ionization chamber such as is used as a standard in determining the roentgen unit.

BIOLOGIC EFFECTS

As the action of these super-soft, infra-roentgen, or Grenz rays, as Bucky has called them, is wholly atomic, despite their long wave lengths, it would be expected that they would follow the quantitative laws already established for the biologic action of radiation by Wood and Packard. In fact, Packard has recently shown with the eggs of *Drosophila* that the biologic action of the soft X-rays of the type under consideration is the same as X-rays of short wave length or gamma rays of radium, the lethal curves superimposing exactly. Clinically, however, the biologic effect may be expected to be somewhat different from that of shorter wave lengths, owing to the fact that the absorption takes place largely in the first few millimeters of the skin. Consonant with this fact, the histologic changes produced have been described as slightly different from those following radiation of the shorter wave lengths, the lesions being somewhat less marked in the vessels and characterized chiefly by proliferation of the connective tissue and certain changes in the stratum granulosum of the epidermis. But it is doubtful whether there exists any fundamental difference between the reactions following the application of any wave length of X-rays to the skin.

APPARATUS

The exciting apparatus may be a step-down transformer, the current for which is obtained from a modern interrupterless X-ray transformer; or, as is usually the case, a special transformer, designed to supply a maximum of 10 kilovolts and 10 milliamperes, is employed. The principle of such a transformer does not differ from that of generators used for short wave X-rays. It is simply a high-tension transformer with a closed iron core. The high-tension transformer is regulated by both autotransformer and resistance control. One of the high tension lines is grounded. There is a small step-down transformer to supply suitable current for the Coolidge filament. A kilovoltmeter and milliamperemeter are built into the switch board. The apparatus has not yet been standardized. Some machines include a thermionic rectifier (kenotron tube) while others deliver an unrectified current. The transformer, with its accessories, is housed in a small cabinet on which is mounted the switch board, controls, tube stand, and the water-cooling device for the tube. The apparatus is designed for use with commercial alternating current. If only direct current is available, a small rotary converter may be installed in the cabinet.

TUBE

The special tube that is most popular for the purpose is a small, water-cooled, unipolar, hot cathode glass tube which, with the exception of the Lindemann glass window, is encased in a metal housing. The tube is delicate; its life is likely to be short. It is important not to touch the Lindemann glass window.

Bucky and Glasser estimate the wave lengths obtained with this special tube and apparatus operating on about 8 kilovolts as ranging from 1.6 to 2.06 Ångström units. The average is about 2 Ångström units. Ultra-violet rays have wave lengths between 4,000 and 15 Ångström units. X-ray wave lengths range from about 15 Ångströms to about 0.06 Ångström. X-ray wave lengths commonly used in radiotherapy are between

0.3 and 0.06 Ångström units. The Grenz rays, therefore, fall well within the X-ray spectrum, but their average length is greater than that previously used for therapeutic purposes. Bucky estimates the longest X-ray wave lengths heretofore employed therapeutically at about 1 Ångström average.

CUTANEOUS REACTIONS

Because of the knowledge of the biologic action of X-rays of various wave lengths, radium, and ultra-violet rays, and particularly the beta rays of low velocity, cathode rays and very soft secondary rays from heavy metals, the biologic effect of Grenz rays is exactly what would be expected. Depending on the size of the dose, cutaneous reactions vary from simple erythema (redness) to vesiculation and erosion, with exudation and crusting. Because most of the radiation (assuming that it has an average wave length of 2 Å.U.) is absorbed by the epidermis and upper layers of the derma (depending considerably on the thickness of the skin, which varies markedly with location and disease), the deep derma and subcutaneous tissues are not likely to be seriously damaged with amounts recommended for therapeutic purposes. Therefore, no deep, indolent, painful ulcers that are so characteristic of third-degree roentgen and radium ulcers have yet been reported. While delayed reactions occur, it is customary for the erythema to appear within twenty-four hours. Regardless of the intensity of the reaction, inflammation usually disappears in a few weeks: deep pigmentation, however, often endures for many months. Several times the erythema dose may be given at one sitting without effecting epilation, although if the dose is sufficiently large, epilation occurs. Four and even six times the erythema dose of short wave length X-rays has been administered to small areas without provoking more than a mild second-degree reaction. A larger amount is apt to cause a serious third-degree reaction. The Grenz-ray erythema dose has been increased considerably more than this without effecting more than an intense erythema, superficial edema, and pigmentation, with, at times, vesiculation, erosion, exudation, and crusting.

Sequelæ thus far have been uncommon. A few cases of mild atrophy and telangiectasia have been reported. Sufficient time has not yet elapsed, and too few patients have been treated, to allow one to estimate accurately the possibility of sequelæ or to determine the possible danger of small and large doses repeated over a considerable period. However, it can be said that Grenz-ray therapy is much safer than therapy with shorter wave lengths, for both deep and superficial tissues. This is especially true for unskilled operators: either method is safe when properly employed. The safety factor in Grenz-ray therapy depends principally on using a tension below 10 kilovolts, preferably about 7 or 8 kilovolts.

TECHNIC

As with short wave length X-rays, Grenz-ray dosage may be estimated by the direct method (photographic and pastille radiometers; spectrometer; electrostatic voltmeter; iontoquantimeter; biologically with seeds or larvæ), or by the indirect method (milliamperage, voltage, time, and distance), or by a combination of the two. Although being improved and simplified rapidly, it will be some time before iontoquantimeters and spectrometers are practicable for the daily routine use of the busy practising physician; therefore, the direct method is not popular in this country either for Grenz rays or for shorter wave length X-rays. In the near future the combined

method is likely to be the choice, but possibly not until there is a larger number of capable physicists. For the combined method it is customary to have a physicist standardize a given apparatus and tube in terms of peak voltage, wave length, roentgen units, and erythema dose; in other words, quantity and quality expressed in milliamperage, voltage, time, and distance. An amount over 200 or 300 roentgen units (half absorption value 0.036 mm. of aluminum) is likely to cause mild erythema. The quantity required for the erythema dose varies considerably with different authors because there is no definite clinical, biologic, or instrumental standard for the erythema dose. Some place it as low as 200 r; others as high as 500 r or even higher. The technic should be checked frequently in the manner mentioned; also every time a new tube is used, an old tube repaired, or when any change is made in the installation. For daily use the operator depends on the four established constants, namely, milliamperage, voltage, time, and distance.

Most operators in this country utilize the indirect method of estimating X-ray dosage regardless of wave length; Grenz rays are included in this statement. They establish the four constants (milliamperage, voltage, time, and distance) for the erythema dose. The voltmeter is first calibrated for peak voltage by means either of a sharp-pointed or of a small sphere spark gap, preferably the latter. This is done by the manufacturer and should be checked occasionally. Eight kilovolts, with 8 milliamperes, will give an average wave length of approximately 2 Å.U. (half absorption value 0.036 mm. of aluminum). The working distance is 6 centimeters. The time factor is obtained by applying the radiation produced by the constants mentioned to small areas of skin on some fairly sensitive part, such as the flexor surface of the forearm of a young adult, in increasing amounts until erythema is evoked. The time is then recorded and added to the other constants. This is called (arbitrarily) the skin unit. Most operators in this country employ the following constants for the erythema dose: 8 milliamperes; 8 kilovolts; 4 minutes at 6 cm. distance. This gives approximately 370 roentgen units (Glasser). These are sea-level values; they may be high for high altitudes. The time factor may be divided for fractional treatments and multiplied for massive dosage. All other factors should remain fixed. A change in any one will necessitate a change in one or more of the others.

Roughly, most of the technical rules relating to shorter wave length X-rays pertain to Grenz-ray therapy; variations in skin toleration due to age, sex, complexion, location, thickness of skin and its various layers, especially the horny layer; disease; idiosyncrasy; impossibility of obtaining an erythema color standard or index; increase of erythema or other visible biologic effect not proportional with increase of quantity or quality of radiation; possible accumulative action of repeated applications; avoidance of extremely large doses, at least until more is known relative to the possibility of undesirable late results. There are exceptions: Grenz rays produce less scattering and fewer secondary rays than do shorter wave lengths; therefore there is less difference in detectable effect when the radiation is applied to large areas as compared to small areas. Because these long wave lengths are absorbed by air, it is necessary to place the tube close to the skin; also distance must be accurately measured and maintained because the percentage of error at a short distance is considerably greater than at the working distance of 8 or 10 inches ordinarily employed with shorter wave lengths. It is advisable to shield the skin immediately around the treated area with thin lead foil. Radiation passes through only the Lindemann glass window; it does not travel far and it does not excite much secondary radia-

tion, therefore it is unnecessary to protect especially the patient's body or the operator.

THERAPEUTIC RESULTS

While the radiation is a valuable therapeutic agent, it is less efficacious, less versatile, and more time-consuming than X-rays of shorter wave length. In spite of the higher degree of safety, the method is not yet suitable for use by any but those who have been adequately trained in X-ray work.

The best field for Grenz-ray therapy is in dermatology. Here, the results have been good, at least in many diseases. It is especially suitable when it is necessary to avoid temporary or permanent injury to important organs and to glandular apparatus in or under the true skin—hair roots, sebaceous and sweat glands, testes, eyes. Even here there are limitations: with heavy dosage or repeated applications, enough of the shorter wave lengths (contained in the heterogeneous beam) may be absorbed by tissue below the epidermis to effect undesirable and perhaps serious injury. However, the method is comparatively safe and very useful for patches of various dermatoses located on the scrotum, eyelids, and scalp—eczema, psoriasis, lichen planus, lupus vulgaris, and basal-cell epithelioma.

With tubes available at present, used at a skin-target distance of 6 cm., the exposed area of skin is a circle having a diameter of about 4 centimeters. Obviously, the method is not suitable for the irradiation of universal, generalized, or extensive eruptions.

Published reports of therapeutic results are yet rather meager and they come from comparatively few workers. Most of the favorable results have been obtained with large doses (erythema dose to several or many times the erythema dose—from 300 or 400 to 3,000 or 4,000 roentgen units administered at one time and repeated, if necessary, at intervals of from one to several months). There has been little experience with fractions of the erythema dose administered once weekly. Thus far fractional treatment has not been especially successful. In general, it is doubtful whether any skin disease (not an individual case) can be cured with Grenz rays that cannot be cured with X-rays of shorter wave lengths or with beta rays of radium. Occasionally, a patch of some inflammatory dermatosis, such as eczema or psoriasis, that is not favorably influenced with very conservative treatment with X-rays of shorter wave length will yield to a massive dose of Grenz rays; more often, shorter wave lengths succeed when Grenz rays fail.

Good results have been obtained in some of the following conditions: patches of eczema of all types, patches of lichen planus and psoriasis, localized essential pruritus, perlèche, warts of various types, lupus vulgaris, Bazin's disease, tuberculosis, verrucosa cutis, scrofuloderma, basal-cell epithelioma, superficial cavernous angioma, strawberry mark, port-wine mark, boils, Kaposi sarcoma, sarcoma of various types, dermatitis herpetiformis, paronychia, ringworm of scalp and skin, acne varioliformis, Darier's disease, mycosis fungoides, and poikiloderma. Poor results have thus far followed the use of Grenz rays in sycosis, xanthoma, acne vulgaris, keloid, dermatitis papillaris capillitii, alopecia areata, prickle-cell epithelioma, tuberculid, and scrofuloderma. With few exceptions the Grenz rays have not yet been tried for skin diseases other than those mentioned.

Bucky presented two cases of port-wine mark before the New York Dermatological Society in January, 1930. A portion of each lesion had been treated with heavy doses of Grenz rays. The treated parts were distinctly paler than the untreated areas. Since then several dermatologists have endeavored to eradicate port-wine marks with massive doses of Grenz rays

without success. It is possible that failure is due to conservatism: several or many large doses are required and until such treatment is proved to be without danger cautious dermatologists hesitate to accept the risk. Bucky employs doses of 4,000 r at intervals of two months.

Several dermatologists have obtained results in lupus vulgaris that seem superior to those possible with shorter wave lengths. However, the difficulty just now is that reports of success and failure are, for the most part, based on too few cases, in many instances only one or two patients having been treated. For this reason and because greater technical knowledge is required, several years must elapse before it will be possible to give an accurate or even fair evaluation of the method. Judging by present knowledge, Bucky's prediction that Grenz rays will replace X-rays of shorter wave length in dermatology is too optimistic.

Attempts have been made to influence various internal diseases by applying Grenz rays to eight areas on the trunk. The same method (so-called general or indirect treatment in contradistinction to direct irradiation of lesions) has been used, also, for some skin diseases, especially those that involve extensive surfaces, those that are characterized by remissions and exacerbations, and those that are definitely due to some general disturbance. The *rationale* of indirect treatment is based on the fact that radiation of various kinds (X-rays, radium, ultra-violet rays) if properly employed will at times provoke temporary leukocytosis (leukocyte sturz); also that through the autonomic nervous system such radiation may affect the endocrine glands, general nervous system, general circulation, metabolism, or vitamins. Bucky believes that the Grenz rays are more efficacious in this respect than radiation of any other wave length. He gives the following technic for indirect treatment: The torso is divided into four areas, front and back (eight in all). On each of eight successive days one field is irradiated at a distance of 15 cm. with from 150 to 300 roentgen units. When the series is completed a second series is given, following the original sequence, but making the exposures every second day. The two series constitute a course of treatment. As a rule, several courses are administered with intervals of rest depending on indications.

Good results for the indirect Grenz-ray treatment are claimed for gastric ulcer, gastric hyperacidity, Banti's disease, polycythemia rubra, hypothyroidism, dysmenorrhea, oligomenorrhea, amenorrhea, hypertrichosis, asthenia, arthritis deformans, asthma, pertussis, angina pectoris, and spastic constipation. Exophthalmic goiter, Hodgkin's disease, and leukemia are not favorably influenced. Indirect treatment was used successfully in a number of skin diseases: acne vulgaris, acne rosacea, universal erythroderma, and urticaria. The effect on acne rosacea is said to be especially good.

The results of indirect Grenz-ray treatment have not yet been corroborated to any extent; also, only a few cases of each disease have been reported. The method and particularly the explanation for the alleged good results have been received with considerable skepticism. It will be necessary to compile statistics from a number of clinics over a period of years before the value of indirect treatment can be ascertained.

SUGGESTED REFERENCES FOR FURTHER READING

1. Abramowitz, E. W.: Physical Therapy in Dermatology. Clin. Med. and Surg., April, 1929, XXXVI, 225.
2. Albers-Schönberg, H. E.: Die Lindemannrohre. Fortschr. a. d. Geb. d. Röntgenstr., 1911, XVII, 225.
3. Arzt, Leopold, and Fuhs, Herbert: Praktisch-therapeutische Erfahrungen mit Buckys Grenzstrahlen. Kongressber., Arch. f. Dermat. u. Syph., 1928, CLV, 79.
4. Blumenthal, Franz: Strahlenbehandlung bei Hautkrankheiten. Karger, Berlin, 1925.
5. Bucky, Gustav: Grenz-ray Therapy, with Contributions by Otto Glasser and Olga Becker-Manheimer, translated by Walter James

Highman. Macmillan Company, New York, 1929.
6. Idem: Reine Oberflächentherapie mit überweichen Röntgenstrahlen. München. med. Wchnschr., May 15, 1925, LXXII, 802.
7. Idem: Rationnelle Hauttherapie durch Grenzstrahlen. Jahresb. f. ärztl. Fortbild., August, 1926, XVII, 19.
8. Idem: Grundlinien und Ausblicke der Grenzstrahlentherapie. Verhandl. d. deutsch. Röntgen. Gesellsch., 1926, XVII, Pt. 2, p. 10.
9. Idem: Tatsächliche Oberflächentherapie und ihre Beziehung zu inneren Organen. Strahlentherapie, 1926, XXIII, 136.
10. Idem: Tatsächliche Oberflächentherapie und ihre Beziehung zu inneren Organen. Verhandl. d. deutsch. Röntgen. Gesellsch., 1926, XVII, 41. (Read by Zollschan.)
11. Idem: "Grenz" (Infra-roentgen) Therapy. Am. Jour. Roentgenol. and Rad. Ther., June, 1927, XVII, 645.
12. Idem: Sarcomatosis of Skin, Lupus Erythematosus, Duhring's Disease, Epitheliomata Treated with "Grenz Rays" (Borderline X-rays). Phys. Ther., August, 1927, XLV, 371.
13. Idem: Grundlinien und Ausblicke der Grenzstrahlentherapie. Strahlentherapie, 1927, XXIV, 524.
14. Idem: Zur Technik der Grenzstrahlentherapie. München. med. Wchnschr., Dec. 16, 1927, LXXIV, 2140.
15. Idem: Aussprach zu den Vorträgen über Grenzstrahlen. Kongressber., Arch. f. Dermat. u. Syph., 1928, CLV, 109.
16. Idem: Ist die "Grenzstrahlentherapie" nach Bucky vollkommen ungefährlich? Strahlentherapie, 1928, XXVIII, 629. Reply to article by Martenstein *et al.*, ibid. XXVI.
17. Idem: Discussion of Dr. C. Lerner's article, "Cases from the Skin Clinic of the Postgraduate Hospital." Phys. Ther., July, 1929, XLVII, 396.
18. Idem: Stand und Ausblicke der Grenzstrahlentherapie. München. med. Wchnschr., June 28, 1929, LXXVI, 1107.
19. Bucky, Gustav, and Freund, Etelka: Die Beeinflussung der Polycythaemia rubra durch Grenzstrahlen. München. med. Wchnschr., Aug. 17, 1928, LXXV, 1405.
20. Bucky, Gustav, and Manheimer, Olga: Der Leukocytensturz bei verschiedenen elektromagnetischen Schwingungen. Ztschr. f. d. ges. phys. Ther., 1926, XXXII, 74.
21. Bucky, Gustav, and Müller, E. F.: Strahlende Energie, Haut und autonomes Nervensystem. München. med. Wchnschr., May 29, 1925, LXXII, 883.
22. Del Buono, Pietro: Contributo alla radioterapie dei cancri cutanei con i raggi molli e ultramolli. Radiol. med., February, 1928, XV, 115.
23. Buschke, Abraham, and Sklarz, Ernst: Die histologischen Befunde an der mit überweichen Röntgenstrahlen bestrahlten Haut von Mäusen und Meerschweinchen; Keratitis und Meerschweinchenauge nach überweicher Bestrahlung. München. med. Wchnschr., May 15, 1925, LXXII, 806.
24. Coolidge, W. D.: Cathode-ray and Roentgen-ray Work in Progress. Am. Jour. Roentgenol. and Rad. Ther., April, 1928, XIX, 313.
25. Dauvillier, Alexandre: Sur un tube à rayons X de longueur d'onde effective égale à 8 unités Ångström. Compt. rend. Acad. d. sc., Dec. 19, 1927, CLXXXV, 1460.
26. Idem: La production, l'utilisation radiologique et le dosage des rayons X de très grande longueur d'onde (7-8 unités Ångström). Bull. et mém. Soc. de radiol. méd. de France, April, 1928, XVI, 135.
27. Idem: Erzeugung, röntgenologische Anwendung und Messung der langwelligen Röntgenstrahlen (bis zum 8 Ångström). Fortschr. a. d. Geb. d. Röntgenstr., April, 1929, XXXIX, 670.
28. Eller, J. J.: Supersoft Roentgen Rays (2 Å.) in Dermatology. Am. Jour. Roentgenol. and Rad. Ther., November, 1927, XVIII, 433.
29. Eller, J. J., and Anderson, N. P.: Will Supersoft Roentgen Rays (1.5-2 Å.U.) Replace the Roentgen Rays (0.177-0.30 Å.U.) Ordinarily Used in the Treatment of Skin Diseases? Arch. Phys. Ther., December, 1927, VIII, 611.
30. Eller, J. J., and Bucky, Gustav: The Use of the "Grenz" (Infra-roentgen) Rays in Dermatologic Conditions: Preliminary Report of Clinical and Biological Observations Arch. Dermat. and Syph., February, 1928, XVII, 221.
31. Frank, Josef: Ueber die Dosimetrie der "Grenzstrahlen." Fortschr. a. d. Geb. d. Röntgenstr., November, 1927, XXXVI, 1071.
32. Fuhs, Herbert: Ueber die Behandlung von Hautkrankheiten mit Buckys Grenzstrahlen. Strahlentherapie, 1927, XXVI, 657.
33. Idem: Zur Grenzstrahlenbehandlung der Dermatosen. Strahlentherapie, 1929, XXXII, 704.
34. Gabriel, Gerhard: Physikalische und biologische Untersuchungen über die sogenannte Grenzstrahlung. Strahlentherapie, 1927, XXIV, 534.
35. Idem: Weitere Untersuchungen über die sog. Grenzstrahlung. Strahlentherapie, 1927, XXVI, 189.
36. Idem: Weitere Untersuchungen über die sogenannte Grenzstrahlung. Verhandl. d. deutsch. Röntgen. Gesellsch., 1927, XVIII, 72. Discussion by Manheimer, p. 73.
37. Gaertner, Otto: Die Bedeutung der weichen Röntgenstrahlen für Bestrahlungsversuchen mit Bakterien. Strahlentherapie, 1926, XXII, 327.
38. Gertz, Willy: Versuche eine Beeinflussung des Ulcusleidens mittels Grenzstrahlen. Strahlentherapie, 1929, XXXII, 489.
39. Glasser, Otto, and Beasley, I. E.: Dosimetrie der Grenzstrahlen mit dem Wintz-Rumpschen Photometer. Strahlentherapie, 1928, XXVIII, 611.
40. Glasser, Otto, and Portmann, U. V.: The Physical and Clinical Foundations of Oversoft Roentgen-ray (Grenz-ray) Therapy. Am. Jour. Roentgenol. and Rad. Ther., May, 1928, XIX, 442.
41. Idem: The Condenser Dosimeter and its Use in Measuring Radiation over a Wide Range of Wave Lengths. Am. Jour. Roentgenol. and Rad. Ther., December, 1928, XX, 505.
42. Holweck, Fernand: Production des rayons X monochromatiques de grande longueur d'onde, action quantique sur les microbes. Compt. rend. Acad. d. sc., Jan. 7, 1929, CLXXXVIII, 197.
43. Holweck, Fernand, and Lacassagne, A.: Étude de la radiosensibilité du Bacillus Prodigiosus aux rayons X mous. Compt. rend. Soc. de biol., April 20, 1929, C, 1101.
44. Kirsch, Hans: Physikalische Untersuchungen

über die Buckyschen Grenzstrahlen. München. med. Wchnschr., April 8, 1927, LXXIV, 578.
45. Idem: Technik und klinische Erfahrungen mit den Buckyschen Grenzstrahlen an der Jenaer Hautklinik. Kongressber., Arch. f. Dermat. u. Syph., 1928, CLV, 82.
46. Idem: Zur Dosierung der Buckyschen Grenzstrahlen. München. med. Wchnschr., April 6, 1928, LXXV, 603.
47. Klövekorn, G. H.: Die Grenzstrahlen und ihre praktische Bedeutung. Therap. d. Gegenw., September, 1928, LXIX, 399.
48. Idem: Zur Dosierung der Grenzstrahlen nach R-Einheiten mit dem Eichstandgerät. Strahlentherapie, 1928, XXIX, 190.
49. Küstner, Hans: Die Dosierung der Buckyschen Grenzstrahlen nach R-Einheiten mit dem Eichstandgerät. Strahlentherapie, 1927, XXVII, 124.
50. Kuhn: Röntgenoberflächenbestrahlung mit verschiedenen Strahlenhärten, insbesondere mit Grenzstrahlen. München. med. Wchnschr., June 24, 1927, LXXIV, 1074.
51. Lawrence, Herman, and Brodie, Robert: The Use of Grenz or Bucky Rays in Dermatology. Med. Jour. Australia, Sept. 7, 1929, XVI, 334.
52. Lerner, Charles: The Physics and Biology of Long Wave Length X-rays (with Special Reference to Dermatology). Phys. Ther., December, 1928, XLVI, 567.
53. Idem: Cases from the Skin Clinic of the Postgraduate Hospital. Phys. Ther., July, 1929, XLVII, 394.
54. Levy, D. M.: Ueber Bucky-Grenzstrahlen in der Dermatologie. Dermat. Wchnschr., Dec. 15, 1928, LXXXVII, 1903.
55. MacKee, G. M.: X-rays and Radium in the Treatment of Diseases of the Skin. Ed. 2. Lea & Febiger, Philadelphia, 1927.
56. Idem: Present Status of Cutaneous Roentgen-ray Therapy. Trans. Sect. Radiol. A. M. A., 1927, p. 75.
57. Idem: Psoriasis: Permanent (?) Injury by the Grenz Ray. Arch. Dermat. and Syph., October, 1928, XVIII, 621.
58. Manheimer, Olga: Buckys Methode zur Rationalisierung der Röntgen-Oberflächentherapie. Dermat. Wchnschr., Aug. 14, 1926, LXXXIII, 1201.
59. Idem: Diskussionsbemerkungen Röntgenkongress, 1927. Verhandl. d. deutsch. Röntgen. Gesellsch., 1927, XVIII, 73.
60. Idem: Die Technik der Grenzbestrahlung. Zentralbl. f. Haut- u. Geschlechtskr., 1927, XXV, 33.
61. Martenstein, Hans: Erwiderung auf die vorstehenden Ausführungen des Herrn Bucky. Strahlentherapie, 1928, XXVIII, 633.
62. Martenstein, Hans, and Granzow-Irrgang, Dorothea: Ist die "Grenzstrahlentherapie" nach Bucky vollkommen ungefährlich? Strahlentherapie, 1927, XXVI, 162.
63. Nijkerk, N.: Overzichtsreferat van de Buckyof Z. G. N. Grensstralen. Nederl. Tijdschr. v. d. Geneesk., Dec. 17, 1927, LXXI, 2621.
64. De Nobele: Les rayons limités de Bucky. Jour. belge radiol., 1928, XVII, 183. Ref. Zentralbl. f. d. ges. Radiol., Jan. 25, 1929, VI, 234.
65. Packard, Charles: The Relation of Wave Length to the Death Rate of *Drosophila* Eggs. Jour. Cancer Res., March, 1929, XIII, 87.
66. Rajewsky, Boris, and Gabriel, Gerhard: Untersuchungen an sehr weichen Röntgenstrahlen (sogenannten Grenzstrahlen). Strahlentherapie, 1928, XXX, 308.
67. Robertson, J. K.: X-rays and X-ray Apparatus. Macmillan Company, New York, 1924, p. 143.
68. Rottmann, H. G.: Zur Kenntnis der Histologie des Grenzstrahlenerythems. Strahlentherapie, 1927, XXVII, 518.
69. Ruete and Freudenberg: Grenzstrahlen und Rachitis. Zentralbl. f. Haut- u. Geschlechtskr., 1927, XXV, 33.
70. Saidman, Jean: Sur les propriétés biologiques des rayons X de 8 Ångström. Compt. rend. Acad. d. sc., Dec. 27, 1927, CLXXXV, 1618.
71. Idem: Sur les propriétés thérapeutiques des rayons X de 8 Ångström. Compt. rend. Acad. d. sc., Jan. 16, 1928, CLXXXVI, 184.
72. Idem: Les rayons de 8 Ångström. Ann. de l'Inst. d'actinol., April, 1928, II, 237.
73. Idem: Les rayons dits de Bucky et les rayons jusqu'a 8 Ångström. Ann. de l'Inst. d'actinol., July, 1928, II, 308.
74. Idem: Un procédé d'actinothérapie rationnelle. Presse med., April 28, 1928, XXXVI, 534.
75. Saidman, Jean, and Cahen, Roger: Sur les propriétés des rayons de 4–8 Ångströms. Compt. rend. Acad. d. sc., Nov. 26, 1928, CLXXXVII, 1000.
76. Schreus, H.: Ist die Grenzstrahlentherapie der bisherigen Oberflächentherapie überlegen? Strahlentherapie, 1928, XXVII, 511.
77. Scholtz: Zur biologischen Wirkung der Röntgen- und Grenzstrahlen. Kongressber., Arch. f. Dermat. u. Syph., 1928, CLV, 94.
78. Schultz, Frank: Die Röntgentherapie in der Dermatologie. Springer, Berlin, 1910, p. 62.
79. Spiethoff, B.: Indikationen und Dosierung der Buckyschen Weichstrahlen in der Dermatologie. München. med. Wchnschr., Nov. 16, 1928, LXXV, 1957.
80. Stern, C.: Ueber die Wirkung der Buckyschen Weichstrahlen auf die Kapsel der Kaninchenniere. Dermat. Wchnschr., Sept. 3, 1927, LXXXV, 1242.
81. Toyama, Ikuzo: Ein Fall von Darier'scher Krankheit, behandelt mit Bucky'schen überweichen Röntgenstrahlen. Japan Jour. Dermat. and Urol., October, 1928, XXVIII, 77.
82. Uhlmann, Erich: Ueber die sogenannten "Grenzstrahlen." München. med. Wchnschr., Dec. 2, 1927, LXXIV, 2080.
83. Idem: Vortrag über die sogenannten Grenzstrahlen. Kongressber., Arch. f. Dermat. u. Syph., 1928, CLV, 90.

EXPERIMENTAL HYPERTHERMIA INDUCED BY THE HIGH FREQUENCY CURRENT

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PART I.—EXPERIMENTS WITH DIATHERMY

IN connection with a study of the use of diathermy in the treatment of general paresis (1) we were enabled to make a comparison of the effects of hyperthermia induced by this method with the results of exposure to a vacuum tube oscillator. The narrow frequency range of the diathermy machine and the physical limitations to its use have restricted its application biologically.

The modern development of the vacuum tube oscillator has opened up a new field, since its use has made possible the investigation of frequencies ranging from 1 million to 158 million and more cycles per second. Very little analytical work has been done on the biological effects of these currents, but it is believed that they differ fundamentally from those produced by any other type of electric current.

Our first experiments were with the diathermy current; the second part of the work was done with the vacuum tube oscillator.[1] The diathermy was tried on human subjects (paretics) and on dogs.

Experiments on Humans (1).—The successful treatment with diathermy depends on certain mechanical factors necessary to produce a rise of temperature, to maintain it, and to prevent burns in the patient. The prime requisites are properly constructed electrodes, a machine powerful enough to deliver sufficient energy, and proper insulation of the subject. The electrodes must have a long edge because the current tends to concentrate along the edges. Fenestrated electrodes accomplish this. Furthermore, when large surfaces of the body are subjected to heavy doses of diathermy current, between 4,000 and 6,000 milliamperes, varying resistances are encountered, depending largely upon thickness. In order to force 6,000 ma. through the body with safety the electrodes must be as large as possible. The entire back must be covered by one electrode and the entire chest and abdomen by another.

The current was applied in such a manner that the maximum temperature (103°–104°F.) was reached after from 3 to 4½ hours. Rectal and mouth temperatures were taken every fifteen minutes. Blood was drawn just before the current was applied, and immediately after the treatment. For the carbon dioxide determinations the blood was collected under a neutral mineral oil.

Results of the Blood Analyses.—Determinations were made of blood chlorides, serum calcium, CO_2 combining power of the plasma, non-protein nitrogen, and uric acid. Six patients in all were examined throughout the entire course of treatment. Non-protein nitrogen and uric acid were determined in only one patient in a course of ten treatments.

Blood Chlorides: Determined by the Van Slyke modification of the Whitehorn method. There was about a 10 per cent increase, which may have been due to the increased concentration of the blood.

[1]The machine was a standard type very kindly furnished us by the Victor X-ray Corporation.

Serum Calcium: Determined by the Clark-Collip modification of the Kramer-Tisdall method. There was about the same percentage of increase as in the chlorides. In some samples, however, the initial calcium value was abnormally low and for this we are unable to account.

Carbon Dioxide Capacity of the Plasma: By the Van Slyke and Cullen method. There was a marked decrease in the CO_2 combining values after treatment, amounting to as much as 20 per cent. The nonprotein nitrogen increased about 10 per cent, and the uric acid increased about 20 per cent.

In a recent paper by Bischoff, Ullmann, Hill, and Long (2) diathermy experiments were tried on six normal individuals. The time of exposure varied from 1½ to 3½ hours. Analyses were made of plasma pH, total CO_2 content, phosphorus, calcium, oxygenation of hemoglobin, and urine pH. These investigators report a slight but definite increase in plasma pH, and a decrease of from 4 to 12 volumes per cent in the total CO_2 content of the blood. Also the pH of the urine remained unchanged or increased, inorganic phosphorus unchanged or decreased, and the hemoglobin more or less highly oxygenated. They explain that the change in the total CO_2 content of the blood is readily accounted for by the shift of base to the blood proteins because of the increase in pH. The fall in the total CO_2 content may or may not signify a lowered alkali reserve, since the pH of the plasma and oxygenation of the hemoglobin have both increased. Semiquantitative calculations which these investigators carried out indicate no change or a slight increase in the alkali reserve.

Experiments on Dogs.—In the application of the diathermy current to the unanesthetized dog we experienced difficulty in preventing body burns around the edges of the electrodes, so that it was impossible to give an animal more than one or two exposures. The dogs were held comfortably in a stock and the electrodes fastened to either side of the thorax. The current was increased gradually until the temperature had risen 4 or 5 degrees F. and then maintained for an hour. Table I shows the blood changes.

It is the growing belief of workers in this field that the effects produced on animals can be fully explained on the basis of the heat generated by the high frequency currents which are induced in them. Thus the chemical changes in experimental hyperthermia should, on this basis, tally closely. In this connection it is interesting to compare results obtained by different methods. Hall and Wakefield (3) studied the effects of heat on the animal organism, and also determined the blood changes. They fitted up a wooden chamber containing a radiator, an electric fan, and wet and dry bulb thermometers. Dogs were exposed in this chamber for from 12 to 75 minutes. The temperature of the chamber as indicated by the dry bulb was about 138 degrees F., of the wet bulb 104 to 112 degrees F., and the rectal temperature of the dogs after the exposure was about 112 degrees F. Blood for analysis was collected under oil from the jugular vein. Determinations were made of NPN, urea N, uric acid, creatinine, sugar, chlorides, CO_2 combining power, lactic acid, serum pH, inorganic P, calcium, and total N. Hall and Wakefield commented on their results as follows: "Following exposure, the experimental animals reacted with the clinical syndrome of heat exhaustion as well as that of thermic fever, indicating the common etiology of these two types of reaction. Blood chemistry observations and pathologic changes indicate great renal injury; the alkali reserve decreased markedly, the lactic acid increased more than 300 per cent, the serum pH decreased, emphasizing the un-

compensated nature of the acidosis." They report also an increase in non-protein nitrogen, calcium, and chlorides.

A comparison of these results on dogs with those obtained by us and by Bischoff and his co-workers on humans, if such a comparison is justifiable, shows agreement except on two values, namely, change in pH and alkali reserve. Bischoff reports that in their human subjects the pH shifts to the alkaline side, and that there is no change or only a slight increase in the alkali reserve. Hall and Wakefield report in their dogs that the pH shifts to the acid side, and that there is a marked decrease in the alkali reserve. The final temperature of their dogs, however, was higher than any of Bischoff's subjects, or of ours. We did not determine the pH, but observed a definite decrease in the plasma CO_2 combining power in both man and dogs. Discrepancies or differences in the effect of hyperthermia on the pH and alkali reserve of the blood are to be expected on the basis of Bazett's (4) discussion of the effect of temperature on the solubility of CO_2, the dissociation of electrolytes and the base-binding capacities of the blood proteins, and because of variations in the response of the respiratory center and in the muscular activity or restlessness. One would expect an increase in CO_2 combining power because of the increased blowing off of CO_2 due to the hyperpnea, but this did not occur in our experiments.

In a series of papers on an experimental study of diathermy, Binger and Christie and co-workers (5) presented evidence to show that there is a passage of current through the interior of the body, that the diathermy currents penetrate the living cell, and that heat production is intracellular as well as extracellular. They are of the opinion that the effects produced on animals can be fully explained on the basis of the heat generated. There is no evidence yet of any other effect of the diathermy current.

SUMMARY

(1) In man, there resulted an increase in blood chlorides, blood calcium, uric acid, and non-protein nitrogen which is best accounted for by the concentration of the blood.

(2) There is a decrease in the CO_2 combining power of the blood, in both man and dogs.

(3) The dogs reacted very much like man with the exception that there was no change or a decrease in the blood chlorides, indicating that in the dogs there is a shift of the chlorides from the blood into the tissues. This appears logical, since the blood chlorides did not increase in the face of a 10 per cent concentration of the blood.

(4) The effects of diathermy current can be explained solely on the basis of heat production.

PART II.—EXPERIMENTS WITH THE VACUUM TUBE OSCILLATOR

Recently there have appeared articles dealing with the biological effects of currents of higher frequency. Gosset and his co-workers (6) published, in 1924, a report on the effect on plant tumors of radiations from a vacuum tube oscillating at 150 million cycles per second. They observed that massive exposures to these rays killed various types of plant tumors, death being preceded by an acceleration in their rate of growth. More recently Schereschewsky (7) has studied the effects of these rays on mice. With the apparatus at his disposal he was able to subject mice to lethal exposures at frequencies varying from 8.3 to 135 million cycles per second. He claimed to have shown that the lethality was maximal when the frequency lay between 20 and 80 million cycles. This phenomenon he ascribed to some selective action of these wave lengths, suggesting that this might be in the

form of electromechanical vibration of the living cell caused by the rapid alternations in polarity of the field. He also observed that while the rectal temperature of a live mouse could be raised from 5 to 6 degrees centigrade by these currents, that of a freshly killed mouse could be raised only from 0.1 to 0.7 degree centigrade in a similar length of time. This, he believed, was evidence to show that the heating effect with these currents was different from the diathermic effect observed at lower frequencies.

Having concluded that there might be a differential action upon tissue cells with regard to frequency, Schereschewsky next investigated the effects of these radiations on transplantable tumors. A total of 403 mice with the mouse sarcoma were treated by radiations at a frequency of about 67 million cycles per second—the frequency which he had found to be most lethal to healthy mice. The radiations were strictly localized to the mass of the tumor, so that any systemic effect was excluded. Out of the total of 403 mice treated only 5.5 per cent actually died of the tumor, 23 per cent recovered, and the remainder died from other causes. In 203 control mice, no case of spontaneous recession of the tumor was observed. Somewhat similar results were obtained with chickens that had Rous sarcoma. Microscopic sections of tumors removed after radiation gave a picture resembling coagulation necrosis.

In a small series of experiments a frequency of 135 million cycles was employed, but these radiations were found to have no demonstrable effect on the tumors, which seems to him to support his hypothesis that a specific frequency may be essential.

In short, Schereschewsky thinks that there are certain wave lengths which have a specific lethal action on living cells. This specific band of frequency lies, he says, between 20 and 80 million cycles per second (*i.e.*, between wave lengths of 15 and 3.8 meters). This same band is also supposed to destroy transplantable tumors in mice and frequencies outside this band have no demonstrable effect.

It is known that the physiological effects of alternating currents can be profoundly changed by changes in frequency. D'Arsonval (8) first showed that as the frequency of alternations is increased a point is reached where stimulation no longer occurs, and the subject merely feels a sensation of warmth and prickling in the skin. This critical frequency lies between 5,000 and 10,000 alternations per second, depending on the strength of the current. As the frequency is still further increased, the prickling sensation disappears, till at 10^6 cycles per second heat production is the only effect which can be demonstrated. Accompanying the change in the physiological response with an increase of frequency, there is thought to be a change in the path of the current through the tissues. Whereas low frequency alternating currents confine themselves almost solely to the extracellular fluids, at a frequency of 10^6 the current actually penetrates the living cell. It does this by reason of the thinness of the dielectric layer surrounding the cell, which transmits the current by means of its capacitance. The heat produced at these frequencies can be wholly accounted for on the basis of ohmic resistance and dielectric loss.

The heating effect of the high frequency waves was discovered more or less accidentally. During developmental research in the General Electric Laboratories on a short wave radio transmitting apparatus heating effects in the vicinity of the antennæ were noted. Miss Hosmer (9) made a preliminary study of the magnitude and characteristics of this heating effect, and found that solutions of different salts, but of the same electrical conductivity, heat alike. She also reported that in rats killed after sublethal treatments the only evidence of tissue dam-

age observed was in the outer layers of the muscle cells of the heart immediately adjacent to the pericardial cavity, and at the tips of the liver lobes.

In view of this knowledge it is interesting to note that Schereschewsky thinks that there are certain wave lengths which have a specific lethal action on living cells. He does not attribute his results to the heating effect accompanying the radiation. His observations, if confirmed, may obviously have a wide range of interest in biology and medicine.

Christie and Loomis, from previous work (5) were convinced that the biological effects of currents of lower frequency could be explained solely on the basis of heat production, and they undertook to find out whether the same was true of currents of higher frequency or whether some specific action on living cells existed. Their experimental work (10) fell into three groups: First, to find if the lethal nature of the radiations was strictly proportionate to their intensity, irrespective of frequency; second, to find if certain frequencies had a specific lethal action on living cells, and third, to find the actual cause of death in animals subjected to these radiations. The results of their experiments are definitely at variance with those obtained by Schereschewsky They show that the lethal nature of these radiations is proportionate to the intensity of the field up to a frequency of about 50 million cycles. At frequencies higher than this, the lethality of the radiations appears to diminish. It must be realized that the standard of current strength was the intensity of the electromagnetic field and not necessarily the amount of current induced in the mouse. They believe that in this lies the explanation of the apparent diminution in the amount of current induced in it. From Debye's equation for the dielectric constant as a function of frequency and viscosity it is apparent that in the region of the shorter wave lengths it is possible that the highly viscous elements of the mouse (fat, epidermis, bone) begin to play an important part in its dielectric properties, and either diminish or increase the power loss. At wave lengths less than 6 meters a mouse ceases to behave in the same manner as an electrolyte. Changes in the dielectric constant of the mouse at these very high frequencies would entail a readjustment of the field in the condenser. The results of these experiments certainly do not suggest that any specificity exists with regard to the action of any particular wave lengths on living cells. The lethal effect of these radiations is diminished at the very low wave lengths, but is probably due to less current being induced in the mouse. The lethal effect of these currents can be fully accounted for on the basis of heat production, being generated by the resistance of the tissues and dielectric loss. Lethal doses of the current at all frequencies are accompanied by the same degree of temperature elevation. Heat production in dead mice parallels that in live mice, irrespective of frequency. Sublethal doses given to mice are without ill effects apart from those which can be accounted for by the local accumulation of heat. Animals which are poikilothermic can be given prolonged exposures without any harmful effect, provided the systemic temperature be kept below the lethal point. The effect of these rays on tumors may also in all probability be accounted for on the basis of heat production. Schereschewsky states that the tumors did not feel hot, but, on the other hand, the microscopic picture of them suggested coagulation necrosis. Direct temperature measurements in the substance of the tumor during radiation would be necessary to rule out the probability that the structural changes observed were not the result of heat.

A histologic study of the tissues of an animal killed by a lethal dose of these ultra-

high frequency waves was made by Baldwin and Nelson (11). They used an oscillating current of from 5 to 6 million cycles under a current strength of from 2 to 4 amperes and 3,000 volts between the plates. Anesthetized albino rats were exposed on alternate days at rectal temperatures of from 40 to 42 degrees centigrade for a period of from ten to thirty minutes. Upon autopsy, they report as observable a definite diminution in the quantity of the body fluids and in blood volume. The ventricles of the heart were filled with clotted blood, usually in complete diastole. The periphery of the lungs, of the heart, and of the liver afforded evidences of an incipient coagulation necrosis. The blood vessels, likewise, in these superficial areas were dilated and filled with clotted blood. In the spleen, liver, kidney, duodenum, and intestines was found cellular mucosal detritus. The capillaries of the intestinal wall were distended and engorged with blood. The stomach, pancreas, sex organs, endocrine and nervous systems appeared normal. Where there was a change it was of the nature of a coagulation necrosis. No evidence was obtained which might afford a basis for the assumption of a selective histologic action of this form of energy. In conclusion, Baldwin and Nelson remark that there exists a striking parallelism between the conditions observed in these experiments and those noted as the results of extreme burns from various sources of external heat, and seem, therefore, to substantiate the conclusions of Christie and Loomis that the changes effected are the result of a true heating condition of the body brought about directly as the result of the oscillating current. Later, Baldwin and Dondale (12) observed the regenerative cycle in adult albino rats subjected to rayings of such intensity that necrotic mucosal conditions prevailed in the intestine. They reported that the regenerative process was begun soon after the last raying and in most instances was completed by the fifth or seventh day. Ultimately the gut was restored to normal histologic appearance, with no scar formation.

A clear demonstration of the effect of high frequency currents upon a single cell is afforded in the experiments of Kahler, Chalkley, and Voegtlin (13), who exposed suspensions of cultured Paramecia to a 4-meter and 30-meter wave. They show that the effect of the high frequency depends primarily upon the production of a rise in temperature in the organism, and offer the following evidence to support their conclusion: (1) Identical behavior of the organism subjected to a gradual rise in temperature brought about by exposure to the high frequency field or direct heating resulted in death in both cases at the same temperature. (2) An absence of any demonstrable biological effect following long continued exposure of the organism to the field at a sublethal temperature, the temperature rise being prevented either by cooling the medium or by suspension of the organism in a non-conducting, non-heating medium. (3) Identical microscopic appearance of an organism killed by exposure in the high frequency field or by ordinary heating. (4) Identical behavior of the organism when exposed to two electric fields differing in frequency. Chalkley (14) later showed that the resistance of Paramecium to a temperature of 40 degrees C. varies with the hydrogen ion concentration of the medium.

McKinley and Charles (15) have noted individual variation in response of *Habrobracon juglandis,* a parasitic wasp, to the same dosage in a high frequency electrostatic field. Wasps placed together in the field for the same length of time may be apparently lifeless, normal, or in any intermediate condition at the end of the exposure.

Mellon, Szymanowski, and Hicks (16) have studied the effects of radiations of 1.9 meters independent of the heat factor. Com-

pletely negative results were obtained in attempts to sterilize milk and to destroy bacteria both *in vivo* and *in vitro*. Local radiation to the site of a streptococcus infection in guinea pigs produced no changes in the course of the infection. With diphtheria toxin they report a definite attenuation, as assayed by skin tests in guinea pigs, the toxicity being so diminished that twenty-five skin test doses injected intradermally gave the same reaction as that obtained with one skin test dose of the control toxin. They found that the type of fluid used for cooling was of very great importance.

The vacuum tube oscillator has recently been used to produce fever in man. Carpenter and Page (17) suspended patients between the plates on interlaced tape stretched across a wooden frame. With the patient on his back and the plates on each side they were able to produce a rise of temperature with no visible discomfort, although trouble from arcing was experienced if the plates were above and below. They believe the development of heat is due to the resistance of the body to the conduction of current between the surfaces adjacent to the opposed plates. At each alternation of polarity of the plates the corresponding polarities are induced upon the adjacent boundaries of the interposed body and current is conducted through the material for a brief interval. They have failed to observe any objectionable effects of exposure to the vacuum tube oscillator of frequency 10 million cycles per second unless extremely high temperatures are maintained for long periods.

EXPERIMENTAL PART

Apparatus.—The apparatus used in our experiments is a vacuum tube oscillator designed by the General Electric Company and loaned to us through the courtesy of Mr. Carl Darnell.

The set is operated from one 110-volt, 60-cycle alternating current main and at normal conditions of operation draws a current of 25 amperes. The power input to the set is then approximately 2.5 kilowatts. An oil-immersed transformer having a 6,500-volt secondary and feeding a full wave rectifier forms the 3,000-volt direct current plate supply for the oscillator. This transformer has a separate winding operating the filaments of the rectifier tubes. An auto-transformer is connected in the primary of the high voltage transformer to provide plate voltage regulation. The rectifier consists of two half-wave hot cathode mercury vapor tubes in conjunction with a filter. A condenser is connected directly across the high voltage D. C. supply. As this condenser provides the peak currents drawn by the oscillator the full plate voltage swing is utilized across the heater plates. The screen-grid voltage for the two PR-861 tubes is supplied from a potentiometer system across the 3,000 volt D. C. supply. (This voltage is approximately 500 volts and is not critical.) Filament power for the oscillator tubes is supplied from a separate transformer. An ammeter is connected in series with the high voltage supply and indicates the total plate current of the oscillator. A shunt feed Hartley circuit operating over a frequency range of from 10,000 to 14,000 kilocycles is used as the oscillator circuit. In this circuit the heater plates are in parallel with the grid and plate coils. The high voltage D. C. is blocked from the heater plates by means of a condenser. A radio frequency ammeter, in series with the heater plates, indicates the current in the tank circuit. The frequency meter consists of a coil tuned by a 125 micromicrofarad, straight line frequency condenser. A neon glow lamp connected to one side of the condenser indicates resonance with the oscillator.

Experiments on Rats.—The electrostatic field between the heater plates is not a homo-

geneous one, and as a result the heating effect varies in different parts of the field. We tested the difference in heating effect at different levels in the field. For this purpose a well-ventilated, three-tiered wooden box was constructed, each tier of such dimensions that a 140-150 gram rat could crawl in but could not move from side to side. The rats could be observed through a glass slip plate which closed the front of the box. By means of a support fastened to the top of the cabinet the box was placed always in the same position between the plates.

After an exposure the rectal temperature of the rat in the top tier showed nearly twice the increase of that of the rat in the bottom tier. The rats were approximately the same weight, and the exposure was five minutes. Table II shows a typical result.

In twenty-three such tests the average rise of temperature of the rat in the top tier was 2.66 degrees F., the average rise of the rat in the bottom tier was 1.50 degrees F., and the average rise of the rat in the middle tier was 2.4 degrees F.

Effect of Daily Hyperthermia on Rats.—Eighteen rats were given an 8-minute raying daily for a month. The average temperature rise was 3 degrees F. each day. The rats stood the exposure well, on the whole, although during the month three died. Autopsy of these revealed a bronchopneumonia, bilateral, in one case, a bowel obstruction with distended gut and peritonitis in the second, and no gross changes in the third. In these instances death could not be attributed to the high frequency current. A histologic study of the organs of three representatives of the remaining rats was made by Dr. O. R. Caillet, of the Department of Pathology. His report follows:

Spleen: A beginning of perifollicular fibrosis. Grossly the spleen does not appear quite as large as normal and the fibrosis is apparently associated with a loss of cellular elements. *Lymph glands:* Some fibrous changes are also present, but not so marked as in the spleen. *Liver:* There is a slight round-cell infiltration throughout the organ, but no other definite pathology suggestive of any chronic changes. *Kidneys, stomach,* and *intestine* show no changes.

A few rats were subjected to only one raying and then examined. Those examined immediately after, showed no changes. Those examined twenty-four hours after, showed changes only in the spleen and lymph glands. Four days after, there was a beginning increase in the number of cellular elements, with marked increase of cells undergoing amitotic division. In short, the changes observed in all these rats closely paralleled those observed in rats exposed to high temperature produced by other means (18). In none of our experiments was any evidence of histologic selectivity of this type of current manifested.

EXPERIMENTS ON DOGS

Lethal Dose: With dogs as the experimental animals we studied the histologic changes in the organs after the dogs had been subjected to a lethal dose. In these animals the temperature was raised to from 110 to 112 degrees F. and kept there for thirty minutes. After the exposure the first animal was unable to stand, but lay on his side panting weakly. Most of the reflexes were absent. The dog was able to drink water but soon vomited it. The feces were bloody. The animal became rapidly weaker and died in four and one-half hours. Autopsy was performed immediately.

The autopsy report is as follows:

Blood and all tissues very cyanotic. *Heart:* Dark in color; pericardium and endocardium cloudy, subpericardial petechial hemorrhage, subendocardial ecchymotic hemorrhage very extensive in the left ventricle. Hemorrhage and edema of valve cusps. *Lungs:* Congested. Infarct in left lower lobe 4 mm. in diameter

and 1 mm. in thickness. Tracheal and bronchial mucosa very hyperemic. *Alimentary tract:* Hemorrhage into stomach, duodenum, jejunum, and upper ileum; mucosa of jejunum sloughing and very hemorrhagic; blood in the lumen. The lower ileum appeared normal. The colon was contracted firmly and the mucosa was hemorrhagic. *Liver:* Very dark in color but not enlarged. *Spleen:* Normal in size but small hemorrhages into the pulp varying from 2 mm. to 5 mm. in diameter. *Kidneys:* Medulla very dark; cortex striations very evident; mucosa of pelvis congested. *Adrenals:* Hemorrhages into the cortex.

A special study of the brain and cord of this animal was made by the Institute of Neurology (Dr. A. Weil). The report showed:

Brain sections show the blood vessels maximally dilated. There are small foci of extra-vascular hemorrhages. The ganglion cells of the cortex show the histologic changes which have been described as "Akute Schwellung." The Nissl bodies have disappeared and the cytoplasm presents itself in cresyl-violet sections as a fine granulated mass. The nucleus contains dark staining granules and the nucleolus stands out distinctly. The outlines of the cells are indistinct, and the cells are slightly swollen. The glia nuclei are well stained. In the spinal cord the changes are essentially the same as in the brain. The hemorrhagic foci are most pronounced in the posterior horns. The anterior horn cells present the picture of acute swelling, as in the brain.

A second dog died sixteen hours after the exposure, with essentially the same histologic changes. The gross changes in the organs closely paralleled death from heat prostration. (It was observed in heating these dogs that the temperature would rise gradually to 107 or 108 degrees F., but would then suddenly shoot up, indicating possibly a breakdown of the heat regulatory mechanism.)

Sublethal Doses: Sublethal doses are apparently without harmful effects, even if given daily. Dogs seem able to withstand a daily temperature rise of from 4 to 6 degrees F. In one series of experiments two dogs were radiated weekly, two dogs twice weekly, one dog daily (for two weeks), and one dog daily for two months. The exposure was at 11 million cycles and was so regulated that the temperature of the animal was kept from 4 to 6 degrees F. above its normal for one hour.

No dog in this series exhibited any ill effects. There was a slight loss of weight at first in the animals subjected to the daily radiating, but no further loss. The weight remained constant at the lower level. The dog radiated daily for two months went into a tonic spasm at the fifteenth treatment when the rectal thermometer was inserted. The spasm lasted three minutes, the current being turned off. Again at the twenty-third, forty-second, and fifty-second exposures tonic spasms of short duration occurred, without the thermometer being inserted. Aside from these spasms the animal manifested no symptoms of ill effects from the exposure to the high frequency current. No other dog had tonic spasms. Seven months after his last treatment this dog was killed and his brain and cord removed for study. The following neurological report on this dog was submitted by Dr. T. T. Stone, of the Department of Neurology.

Cord Dorsal 1: Many ganglion cells are enlarged and rounder than normal. Nissl granules do not stain definitely, but appear like dusted particles. Nucleus is centrally placed in most of the cells. Many ganglion cells show neuronophagia (satellite neuroglial cells surrounding the ganglion cell). No blood vessel abnormality. No evidence of fresh hemorrhages. No leptomeningeal reaction. Sensory gray matter is normal.

Frontal Lobe: Many ganglion cells do not take the nuclear stain. The Nissl granules are almost replaced by a powdery looking substance. Cells are of normal size. Architectonic arrangement of the cortex is retained. White matter shows a few distended blood vessels, with no changes in their walls. Leptomeninges show a moderate infiltration of large mononuclears, small round cells; an occasional polymorphonuclear leukocyte is seen in the leptomeninges. Van Gieson stains show evidence of red cells in the leptomeninges. Blood vessels are distended.

Hematoxylin-eosin sections show evidence

TABLE I

	Temp. degrees F.		Calcium (mg. per 100 c.c.)		Chlorides (mg. NaCl/100 c.c.)		CO_2 Combining power of plasma		Total solids	
	Before	After	Before	After	Before	After	Before	After	Before	After
Dog 1 *(a)*	101.6	105.3	10.6	11.0	477	477	38	29	22.1	22.7
Dog 1 *(b)*	102.6	105.8	10.4	11.2	468	468	47	34	21.6	23.5
Dog 2	101.9	106.0	10.4	10.4	484	464	40	30		
Dog 3	101.6	106.0	10.2	11.2	473	463	38	29	21.9	24.0

TABLE II

	Initial temp.	Final temp.	Change
Top	100.0° F.	103.0° F.	3.0° F.
Middle	99.4	101.2	1.8
Bottom	100.6	102.1	1.5
Top	99.0	102.6	3.6
Middle	99.8	102.3	2.5
Bottom	99.6	101.2	1.6

TABLE III

	Temperature		Calcium		Chlorides		CO_2 Combining power		Total solids	
	Before	After	Before	After	Before	After	Before	After	Before	After
1	101.5	106.0	10.4	10.4	503	522	34.4	27.7	19.7	21.0
2	102.1	106.8	10.3	10.6	491	512	48.1	37.6		
3	102.3	109.0	10.3	11.3	526	498	42.0	20.0	17.1	21.6
4	102.3	108.1	10.3	11.0	502	473	50.2	33.0		
5	102.3	107.4	10.0	10.9	510	509	51.0	23.0		

of hemorrhage in the leptomeninges. There are many types of blood elements, leukocytes, lymphocytes, and plasma cells situated in the meningeal spaces.

Parietal Lobe: Blood vessels of the meninges are distended. Many cellular elements, as above, present in the leptomeningeal spaces. Hemorrhage is present here, also. The architectonic arrangement of the gray matter is not disturbed. Several motor cells (Betz) show a powdery appearance of the Nissl granules immediately around the nuclei, which are centrally placed.

Temporal Lobe: This area shows a marked distention of blood vessels of the leptomeninges, with many cellular elements around the spaces and in them. The ganglion cells are increased in size (seem swollen). There is no change in the Nissl bodies, or processes. Many of the cells in this section show marked increase in stainability of the Nissl granules. Blood vessels of the white matter are distended.

Pons and Medulla: Show distention of blood vessels of meninges, with cellular elements as mentioned above. The cells are enlarged. No blood vessel or any other cellular change.

Cerebellum: The vessels around the periphery are distended. The Purkinje cells are enlarged. No other abnormal findings. In the hematoxylin-eosin sections the granular cell layer appears to be broken and the cells misplaced.

Conclusion: The brain showed an acute edema, confined primarily to the leptomeninges and the cortex. Microscopically there was definite evidence of distention of blood vessels, with extravasation of cellular elements in the leptomeninges. The ganglion cells of the brain and cord showed an acute reparable process primarily involving the Nissl bodies and affecting the size of the cell.

TABLE IV

	Initial temp. (degrees F.)	¼ hour	½ hour	1 hour	Change	
Vagina	93.3	93.3	95.3	100.4	7.1	
Liver	93.6	95.6	97.6	103.4	9.8	
Spleen	92.0	95.2	97.5	103.4	11.4	
Gut	93.6	95.5	97.5	102.6	9.0	
	Initial temp. (degrees F.)	20 min.	1 hour	1½ hours	2½ hours	Change
Rectum	97.4	98.9	103.3	106.5	110.0	12.6
Kidney	97.5	99.1	102.8	105.7	108.6	11.1
Femur	96.5	98.4	102.6	105.8	109.0	12.5
Brain	97.7	99.3	103.3	106.4	109.2	11.5

TABLE V

	Initial temp. (degrees F.)	½ hour	1 hour	1½ hours	2 hours				
Rectum	96.4	100.0	103.0	106.1	107.5				
Cord	94.4	97.8	101.1	104.1	105.0				
Kidney	96.2	99.9	103.1	105.4	106.4				
Brain	95.5	99.9	103.1	105.6	106.5				
The dog was allowed to cool down, then killed by ether intracardiac, then re-exposed.									
	Initial temp. (degrees F.)	20 min.	45 min.	1½ hours	2¼ hours	2¾ hours	3¼ hours	3¾ hours	4¼ hours
Rectum	99.0	97.4	97.0	98.8	101.0	102.7	105.3	106.9	109.0
Cord	94.3	91.2	90.8	91.8	94.5	94.6	96.1	97.8	99.3
Kidney	94.4	94.4	96.5	96.5	100.5	100.9	103.2	104.6	107.0
Brain	93.4	?	?	90.6	93.0	95.1	97.1	99.5	101.0

There was no evidence of irreparable damage to any part of the brain or cord.

The blood chemistry changes noted were essentially the same as those recorded in our determinations of the blood changes in dogs and men subjected to a diathermy current. Blood calcium remained unchanged or rose; chlorides remained unchanged, fell, or rose; alkali reserve decreased markedly (the animals became restless, and panted), and total solids increased about 10 per cent. The number of red and white cells increased also, undoubtedly due to the concentration of the blood. The blood chemistry determinations were made on the blood of the dog which was radiated weekly. Table III shows the results on the dog. At the fourth heating the non-protein nitrogen and uric acid were also determined. The NPN went from 19.7 mg. per 100 c.c. to 23.4 and the uric acid changed from 1.42 to 1.91 mg. per 100 c.c. At the fifth treatment the NPN changed from 13.6 to 19.6, and the uric acid changed from 1.36 to 1.8.

From a comparison of these results with those resulting from a diathermy treatment it is seen that the changes are very similar. There appears to be a concentration of the blood. The chlorides respond irregularly, sometimes increasing, sometimes decreasing. A prolonged exposure to the vacuum tube oscillator where the rectal temperature rises above 110 degrees F. results in a death, in which the histologic changes observed

TABLE VI

	Initial temp. (degrees F.)	40 min.	70 min.
Rectum	98.4	103.3	106.6
Kidney	98.4	104.1	106.0
Brain	99.2	105.2	107.6
Spleen	97.7	103.0	105.7
Room	37.7 C.	40.0 C.	41.3 C.
The dog was allowed to cool down in the icebox, then killed and re-exposed.			
	Initial temp. (degrees F.)	70 min.	
Rectum	99.4	103.6	
Kidney	99.6	99.0	
Brain	99.0	99.1	
Spleen	94.4	96.1	
Room	39.0 C.	42.0 C.	

closely resemble those resulting in death from heat prostration.

DO DIFFERENT ORGANS HEAT AT DIFFERENT RATES?

In the live anesthetized animal exposed to the high frequency current the different organs are heating up at approximately the same rate. The blood evidently serves as a very efficient distributing agent to maintain a uniform temperature. This is clearly shown by the following experiment. The viscera of a dog under barbital anesthesia are exposed, and the animal is placed in the high frequency field. Temperatures are taken at 15-minute intervals, the same thermometer being inserted to the same depth each time. Six such experiments were done in a constant temperature room, different combinations of organs being taken each time. Table IV shows the typical record of two dogs.

Conditions are different, however, in the dead animal. In death, there is no distributing medium of the generated heat, and different organs heat up at different rates. If heat were being generated by the radiations in both the live and dead dog at the same rate, one would expect the dead animal to heat up more quickly, since in the dead dog heat loss is reduced to a minimum, while in the live dog the heat-regulating mechanism is allowed to operate unhampered.

To obtain information on this point we subjected four barbitalized dogs with viscera exposed to the high frequency current, taking records of the heating of the organs during life. The dog was then allowed to cool down to his initial temperature, killed, and the exposure repeated in the same constant temperature room. In these experiments the animal was so placed in the stock that the head was not in the electrostatic field. The results are striking, as shown by the typical results recorded in Table V.

It is clearly seen from the tabulation that in the dead animal the different organs do not heat up at the same rate. Not only do the organs not heat up as quickly in the dead animal as in the live one, but more than twice as much time is required to achieve the same temperature elevation. These results were confirmed in the other three experiments.

These observations naturally raised the question of why the live dogs heated up faster. The live dog is losing heat by respiration, the other heat losses being identical in both live and dead dog. The live dog is, of course, producing heat because of its metabolism, which does not occur in the

dead dog. Since it was impractical to measure the temperature of all the tissues in the dead dog simultaneously it was necessary to determine the caloric increase calorimetrically.

For this purpose a calorimeter was constructed large enough to accommodate a 7-kilo dog. The technic for estimating the caloric increase was the same as that given by Christie and Loomis (10). The specific heat of dogs was determined directly, as no figures were available for this value. To do this, ten dead dogs of known weight were placed in a constant temperature oven at 40 degrees C. for periods varying from ten to twenty-four hours. They were then immediately transferred to the calorimeter and the increase of temperature noted after equilibrium had been reached. From the observed temperature rise the specific heat was calculated. The average value obtained was 0.69, a figure in close agreement with the value secured by Christie and Loomis for mice.

In this next series of experiments the live dog was radiated for a fixed period of time, the temperatures recorded, the animal was allowed to cool down, then killed and re-exposed. In detail, when the rectal temperature had returned to normal the dog was immediately killed by intracardiac injection of chloroform and replaced in the field. The final temperature of the dead dog was estimated calorimetrically. In these experiments we found that the total elevation of temperature in dead dogs was considerably less than that found in live dogs. (We sought an explanation for this fact in the consideration that the live animal, while confined in the stock it is necessary to put him in in order to radiate him, is quite active, and this increased muscular activity leads to an increase in metabolism and to a higher temperature.) We thought also that the difference in temperature between the room and the dog resulted in a significant radiation loss. To obviate both these objections the next series of animals were anesthetized with barbital, and the temperature of the room was raised to the initial temperature of the dog. The experiments on the animals with exposed viscera were repeated first. A typical result is shown in Table VI, one of four similar experiments.

The experiments on live dogs not operated upon under barbital anesthesia and on dead dogs in which the temperature change was estimated calorimetrically indicated that the radiation loss and increased activity of the confined animal are factors which contribute to the difference between the temperature rise observed in live and dead animals, but that they are not enough to account for this difference. In five animals investigated under these conditions the average temperature increase in the live anesthetized animal was 6.2 degrees F. for an average exposure of 38 minutes, while in the dead animals the average increase was 2.0 degrees F. (in one animal there was no change). It is possible that an overlooked calorimeter heat loss may be an important factor. Allowance for as much as a 25 per cent heat loss, which is extremely unlikely, does not bridge the gap. If heat is being generated by the radiations in both the live and dead dogs at the same rate, the elevation of temperature in live anesthetized dogs is considerably greater than that found in dead dogs. These results on dogs are contrary to the results on mice reported by Christie and Loomis (10). A possible explanation for the difference in these results may lie in the vast difference in mass radiated and in the length of exposure. Christie and Loomis used 20-gram mice and their average exposure was less than 10 minutes (in one case 29.8 minutes). The weight of our dogs was between 5 and 7 kilos, and the duration of exposure was never less than 38 minutes. Also, the basal metabolism of the live animal may play an

important rôle in its increased temperature rise, as it is known that for a 1 degree F. rise in temperature there is a 7.2 per cent increase in the basal metabolism. This energy is largely converted into heat and can contribute materially to the temperature elevation.

SUMMARY AND CONCLUSIONS

1. The biological effects of electromagnetic waves emitted by a vacuum tube oscillator have been studied at frequencies between 10,000 and 14,000 kilocycles per second.

2. The electrostatic field between the plates is not homogeneous, the heating effect varying in different parts of the field.

3. Sublethal doses given to rats daily for a month and to a dog daily for two months are without ill effects. The histologic changes are those found in animals subjected to hyperthermia induced by other means.

4. The lethal effect of these currents can be fully accounted for on the basis of heat production. The histologic changes observed closely parallel those in death from heat prostration.

5. The blood chemistry changes observed in dogs subjected to sublethal doses are very similar to the blood changes noted in the diathermy experiments: Calcium was unchanged or rose, chlorides increased or decreased, CO_2 combining power decreased markedly; total solids, non-protein nitrogen, and uric acid increased.

6. In the live anesthetized dog with viscera exposed, the different organs heat up at approximately the same rate, the blood serving as a very efficient distributing mechanism of the generated heat. In the dead dog the different organs heat up at different rates. Also, live anesthetized dogs heat up at a faster rate than dead dogs.

7. The effects produced on animals of the diathermy current and the electromagnetic waves emitted by a vacuum tube oscillator can be fully explained on the basis of the heat generated by high frequency currents which are induced in them.

I wish to express my appreciation to Dr. A. C. Ivy for his kindly and stimulating help in the investigation of this problem.

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BIBLOGRAPHY

(1) Neymann, Clarence A., and Osborne, S. L.: Jour. Am. Med. Assn., Jan. 3, 1931, XCVI, 7.

(2) Bischoff, F., Ullmann, Henry J., Hill, E., and Long, M. L.: Jour. Biol. Chem., February, 1930, LXXXV, 675.

(3) Hall, W. W., and Wakefield, E. G.: Jour. Am. Med. Assn., July 16, 1927, LXXXIX, 177.

(4) Bazett, H. C.: Physiol. Rev., October, 1927, VII, 531.

(5) Binger, Carl A. L., and Christie, Ronald V.: Jour. Exper. Med., Oct. 1, 1927, XLVI, 571, 585, 595.
Christie, Ronald V., and Binger, Carl A. L.: Jour. Exper. Med., Oct. 1, 1927, XLVI, 715.
Christie, Ronald V., Ehrich, Wilhelm, and Binger, Carl A. L.: Jour. Exper. Med., April 1, 1928, XLVII, 741.
Christie, Ronald V.: Jour. Exper. Med., August, 1928, XLVIII, 235.

(6) Gosset, A., Gutmann, A., Lakhowsky, G., and Magrou, J.: Compt. rend. Soc. de Biol., 1924, XCI, 626.

(7) Schereschewsky, J. W.: Pub. Health Repts., Sept. 10, 1926, XLI, 1939.
Idem: Pub. Health Repts., April 20, 1928, XLIII, 927.

(8) D'Arsonval, A.: Arch. Physiol. Norm. et Path., 1893, V, 401.

(9) Hosmer, Helen R.: Science, Oct. 5, 1928, LXVIII, 325.

(10) Christie, Ronald V., and Loomis, A. L.: Jour. Exper. Med., February, 1929, XLIX, 303.

(11) Baldwin, W. M., and Nelson, W. C.: Proc. Soc. Exper. Biol. and Med., April, 1929, XXVI, 588.

(12) Baldwin, W. M., and Dondale, M.: Proc. Soc. Exper. Biol. and Med., October, 1929, XXVII, 65.

(13) Kahler, H., Chalkley, H. W., and Voegtlin, C.: Pub. Health Repts., Feb. 15, 1929, XLIV, 339.

(14) Chalkley, H. W.: Pub. Health Repts., March 7, 1930, XLV, 481.

(15) McKinley, G. Murray, and Charles, Donald R.: Science, May 9, 1930, LXXI, 490.

(16) Mellon, Ralph R., Szymanowski, Waclaw

T., and HICKS, ROBERT A.: Science, Aug. 15, 1930, LXXII, 174.
(17) CARPENTER, C. M., and PAGE, A. B.: Science, May 2, 1930, LXXI, 450.
(18) CAILLET, O. R., and SIMONDS, J. P.: Arch. Path., October, 1929, VIII, 622.

Radiation from Wireless Valves. H. M. S Turner. Lancet, Dec. 27, 1930, CCXIX, 1437.

High-power wireless valves are provided with a water-jacket or a highly refractory substance may be used instead of glass, with air-cooling. In certain valves fused silica is used for this purpose. Valves of this type were tested by exposing X-ray films to the emanations from the tubes. Each film was enclosed in its light-proof container and one film, in its container, was enclosed in an envelope made from thick sheet-lead, on the front of which a cross had been cut out after the manner of a stencil. In front of the others, letters cut from sheet-lead were closely applied. The exposure was two hours, with the films at a distance of eight inches from the valve tubes. The voltage uniformly throughout the exposure was 9,000 and the milliamperemeter reading was 160 to 170. All the films, when developed, showed the effect of the radiation, and reproductions of these radiograms are shown in the article. It is suggested that an individual working constantly in rather close proximity to the tubes might possibly receive enough radiation to get the so-called cumulative effect, even if small. No history of erythema or any other indication of effect on the attendants about these tubes could be found, but for obvious reasons no leading questions were asked. It is suggested that perfect protection be obtained by screening the valves with metal or lead glass screens of suitable proportions. The penetrating power of these radiations was not determined, as no means were at hand for measuring it, and no estimate of the quantity by any of the standard units used in the work with the roentgen ray was made. The author desired to record the fact that radiograms can be taken by the agency of such valves.

H. J. ULLMANN, M.D.

X-rays in Stars. A. S. Eddington. Strahlentherapie, 1930, XXXVII, 1.

This is the German translation of a well written lecture which English readers interested in the subject may find in the *British Journal of Radiology*, March, 1930, III, 99.

ERNST A. POHLE, M.D., Ph.D.

THE OBLIQUE PROJECTION IN EXAMINATION OF THE LUMBAR SPINE[1]

By M. J. HUBENY, M.D., CHICAGO, ILLINOIS

THE prime object in making a diagnosis is to be able to select the proper remedial measures, to alleviate or cure a disease, or to prevent unnecessary detrimental interferences. However, since the enactment of legislation under which the employer is obliged to compensate an employee for injuries sustained during the performance of his duties, a new condition has arisen requiring proper adjudication to all concerned; certainly, this means of compensation is a proper responsibility to offset more or less disability, either permanent or temporary, with the consequent inability to enjoy the fruits of a gainful occupation.

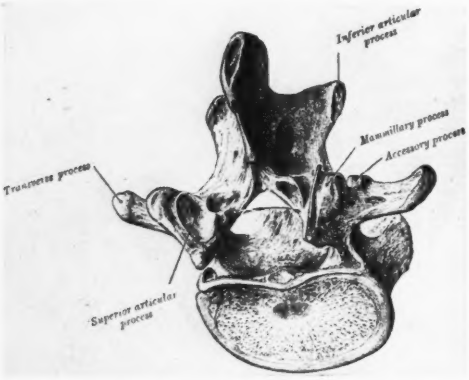


Fig. 1. Typical lumbar vertebra. Note direction of articular facets.

As in most instances in which a monetary gain is possible, malingering immediately becomes a common practice, especially successful if collusion exists among a dishonest patient, a dishonest lawyer, and a dishonest doctor; hence it becomes apparent that great care must be exercised to circumvent such practices.

Subjective symptoms can never be completely disputed; however, the precise methods now possible in scientific medicine reduce many of these symptoms to tangible entities because they must be reconciled with sound thinking and new facts.

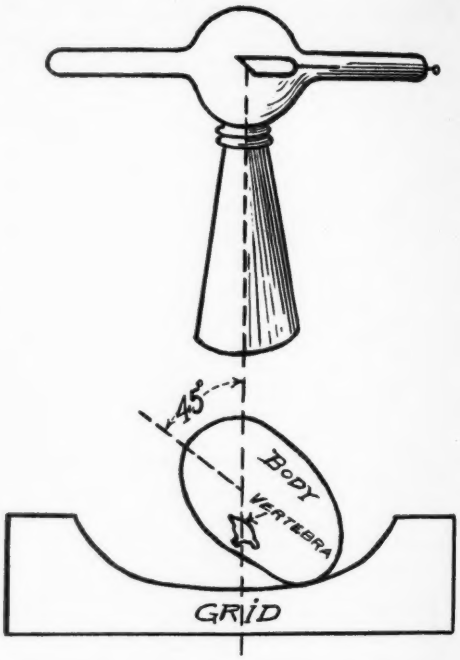


Fig. 2. Schematic drawing showing relationship of tube, spine, and film.

In injuries, the skeletal system is frequently involved, and, by means of a proper and thorough roentgen examination, certain possibilities are definitely established, either positively or negatively.

The roentgenologist should be free to choose all the angles necessary, particularly when the spinal column is under investigation. It is constructed of a number of

[1]Read before the Radiological Society of North America at the Sixteenth Annual Meeting, at Los Angeles, Dec. 1–5, 1930.

Fig. 3. Figures 3, 4, 5, and 6 are of the same patient. Above (Fig. 3) is the antero-posterior projection. The articular facets between the fifth lumbar vertebra and the sacrum are not satisfactorily seen (cf. Figs. 4 and 5). Does the left fifth transverse process make contact with the ilium (cf. Fig. 6)? No, it does not.

Fig. 4. Compare facets marked "1" with facets marked "2" on Figure 5. Note arthritic changes of the latter.

Fig. 5.

pieces, securely connected together and having only a slight degree of movement between any two individual pieces, though permitting of a very considerable range of movement as a whole, allowing a sufficient mobility with a minimum diminution of strength.

The main joints of which the spine is composed, together with the varied movements to which it is subjected, render it liable to sprains, which may complicate other injuries or may exist alone, but so closely are the individual vertebræ articulated that these sprains are seldom severe and an amount of violence sufficiently great to produce tearing of the ligaments would tend to cause a fracture or dislocation. The further safety of the column and its freedom from liability to injury are provided for by its arrangement in curves instead of one straight line. For it is an elastic column and must first bend before it breaks. Under these circumstances, being made up of three curves, it represents three columns, and greater force is required to produce bending of a short column than of a longer one that is equal to it in breadth and material. Again, the safety of the column is provided for by the interposition of the intervertebral discs between the bodies of the vertebræ, which act as buffers in counteracting the effects of violent jars or shocks.

Fracture dislocation of the vertebral column may be caused by direct or indirect violence or by a combination of the two. The fractures from indirect violence are the more common and here the bodies of the vertebræ are compressed, while the arches are torn asunder; in fractures from direct violence the arches are compressed and the bodies of the vertebræ are separated from each other. It will, therefore, be seen that in both classes of injury the spinal cord is the part least likely to be injured and may escape damage even when there has been

Fig. 6. The fifth left transverse process does not contact with the ilium (cf. Fig. 3).

Figs. 7, 8, and 9. These three films are of the same patient. Essential diagnosis was "preternatural mobility of the fourth and fifth lumbar bodies due to faulty development of the right articular facets." The oblique projections show pretty good mechanical arrangement and development of these facets. A bone transplant was advised, but the patient objected. After the removal of a highly adherent appendix, the predominating symptom of intense right lumbar backache disappeared.

considerable damage to the bony framework.

The parts of the vertebral column most liable to be injured are, first, the thoraco-lumbar region; second, the cervico-thoracic region; third, the atlanto-axial region.

ANGLES FOR STUDY

This paper has to deal with a technic especially adapted for a more detailed study of the bodies of the lower dorsal vertebræ, the lumbar spine, and the upper sacral segments.

It is not intended to displace the usual angles, namely, flat or stereoscopic antero-posterior projections and the lateral projections, but to amplify them; as a matter of fact, a flat antero-posterior plus the two

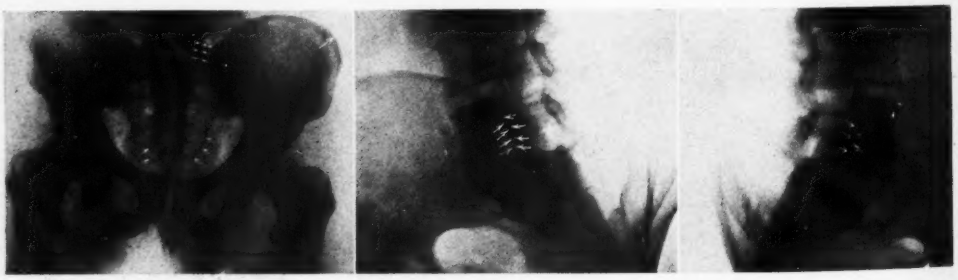
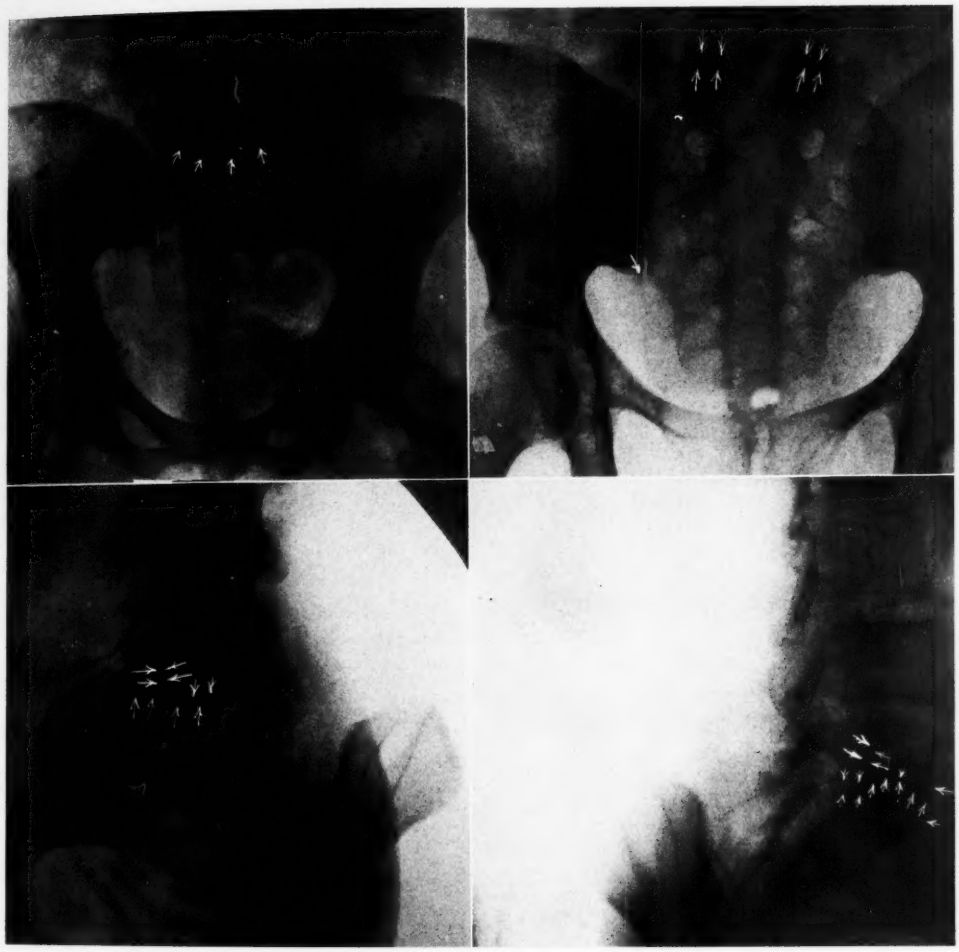


Fig. 10. Fig. 11. Fig. 12.

Figs. 10, 11, and 12. These three films are of the same patient. Asymmetrical pelvis. The adjoining left facets of the fifth lumbar vertebra and sacrum are visible in Figure 10 and also in Figure 12, while the corresponding right facets do not show in Figure 10, but do show in Figure 11.



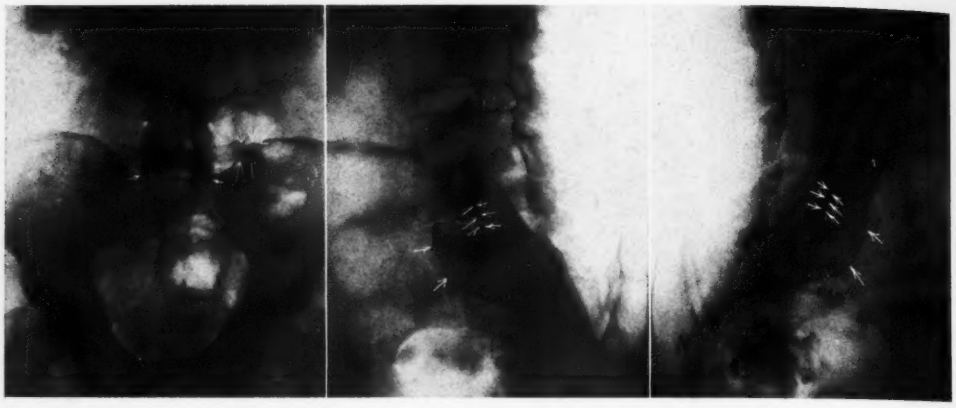
Figs. 13, 14, 15, and 16. These four films are of the same patient. Sacralized fifth lumbar vertebra. The arrows in Figure 13 *(upper left)* call attention to what was considered a possible over-riding.

Fig. 14 *(upper right)*. The central beam is lower than in the case of Figure 13; also directed cephalic-ward. This is a more satisfactory film than the one shown in Figure 13, but still unsatisfactory (cf. Figs. 15 and 16).

Figs. 15 and 16 *(lower left and right, respectively)*. These films show no over-riding. They do show the articular facets, a horizontal promontory, and irregularity of the adjoining surfaces of the fifth lumbar body and sacrum.

oblique projections to be described are the ones of choice, to be used routinely.

The articular facets, the relation of the transverse processes of the fifth lumbar vertebra to the ilia, and the apposition of the fifth lumbar vertebra to the sacrum are more definitely outlined, also many times the spinous processes of the fourth and fifth lumbar vertebræ are depicted with greater clarity. It is surprising to get bone detail and architecture far surpassing the complete lateral projection. The reason is quite obvious: first, the part under examination is closer to the film; second, the



Figs. 17, 18, and 19. These three films are of the same patient. Calcification of the left ilio-lumbar ligament. The facets of the sacrum and the adjoining ones of the fifth lumbar vertebra are not satisfactorily demonstrable. In Figure 18 *(center)* note the clarity of the facets, also the relationship of the fifth lumbar body to the sacrum.

thickness is considerably lessened in the oblique position.

The lateral projection is unsatisfactory in tracing the articular facets; since the superior facets tend to face inward and backward and the inferior facets forward and outward it becomes apparent that placing the body at an angle is a necessity.

TECHNIC

Use large films for a general survey only; for detail, smaller films are to be used. Naturally, double screens, duplitized films, and a Potter-Bucky diaphragm are necessary. The technical factors are left to the discretion of the roentgenologist.

The patient lies partly on the right side so that the transverse line is approximately forty-five degrees to the horizontal plane (namely, the top of the table). The spinous processes should be in the mid-line of the diaphragm and will be elevated a short distance therefrom, because the patient is tilted with the left side of the body away from the film. The central beam is perpendicular to the film, and directed over the particular area under suspicion.

The mate to this film is taken next, repeating this process with the exception that the patient lies on the left side. In this way the two sides are portrayed for comparison, one showing the details of the articular facets, neural arches, etc., of one side, while the mate depicts those of the other side.

This examination is especially useful in detecting pathologic conditions of the facets and is far superior to other methods in detecting fractures of the bodies, dislocations, and spondylolisthetic involvements.

SYMPOSIUM ON PHYSICAL THERAPY

INTRODUCTION BY ERNST A. POHLE, M.D., PH.D., PROFESSOR OF RADIOLOGY
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THE science of radiology embraces the application of the entire electromagnetic spectrum in clinical work. While many of you limit yourselves in your chosen field to the use of roentgen rays and radium for diagnosis and therapy, there are also many, and I believe it is a steadily growing number, who have added other parts of the spectrum, for instance, ultraviolet radiation and other closely related fields, such as high frequency currents, to their therapeutic armamentarium. This development, I believe, is a desirable one, and a few examples may illustrate my statement. Most striking in this respect is the successful combination of electrocoagulation and X-rays or radium in the removal of malignant tumors. There is also the use of ultra-violet radiation in clearing up secondary infection in post-operative cases, or for general body exposure in connection with local roentgen or radium treatment of patients with lessened resistance.

Similar considerations have induced your President to place a Symposium on Physical Therapy on the program. Although the three papers in this symposium will cover some phases of physical therapy which are not so closely related to the daily work of the radiologist, I trust that they will arouse your interest sufficiently so that you too will join in helping to promote the scientific development of physical therapy. In addition to these papers, there will be practical demonstrations showing the different types of apparatus available at present for the production of ultra-violet rays, high frequency currents for diathermy, desiccation and coagulation, including the endotherm knife, and also some measuring instruments designed for clinical use.

EDUCATIONAL PROBLEMS IN PHYSICAL THERAPY[1]

By WILLIS S. PECK, M.D., Director, Department of Physical Therapy,
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THE medical profession is now employing physical therapeutic methods to a greater extent than in the past, because scientific investigation and application have shown that they have a definite place in medical practice. Physicians and physicists interested in the various branches of this field are frequently adding more accurate information. The difficulty which prevents more rapid dissemination of the present knowledge is the lack of sufficient opportunity for the physician and his assistants to gain adequate instruction.

The limits of the field of physical therapy are not well defined, so that many procedures are instituted under this name which are really not a part of it. It is also true that there are many methods employed under the name of physical therapy which are not physiologically sound. For this reason it is clear that, until fancies are separated from facts and the practice is placed upon a more rational basis, the inquiring physician may often look askance at some of the procedures.

The further advancement of physical therapy will depend to a great extent upon the value which can be derived from these methods. When more experimental and clinical evidence has been found which will point to the correct use and define the limitations of the measures, the profession will manifest a more active interest and their efforts will be much more intelligently directed.

It is, therefore, the present situation in regard to instruction in physical therapy which will be considered in this paper.

There are three groups of individuals who are particularly interested in this work: physicians, undergraduate medical students, and technicians. Because of the different points of view and interests of these groups each must be considered separately. The first group is composed of physicians who desire to practise physical therapy, those who wish to use the methods in conjunction with their general practice or specialty, and those who refer their cases for treatment.

For the physician who expects to limit his practice to physical therapy, or roentgenology and physical therapy, there are very few short and intensive courses that are worth while. Usually, the physician must visit several different hospitals and pick up in a desultory fashion whatever appears of value. Because of this lack of educational facilities for the physician who specializes in physical therapy, the caliber of his work is frequently not so high as that found in other special medical fields. It is necessary, therefore, that teaching institutions equip themselves for more complete instruction in this type of work.

The physician who would like to add one or more physical therapeutic methods to his practice finds in teaching institutions little opportunity for organized work such as he desires. Provision for such work is one of the most outstanding needs at the present time. To meet this demand, one institution through its post-graduate department accepts physicians who wish to study and observe special phases of the subject for short lengths of time. A small fee is charged, and the responsibility of assisting the visiting physician in his study and observation is placed upon the physical therapist. Although this arrangement is not entirely satisfactory, much valuable information may be imparted. There is no doubt but that this does place the visiting physician in a different category from that

[1]Read before the Radiological Society of North America at the Sixteenth Annual Meeting, at Los Angeles, December 1–5, 1930.

of one who makes a few casual visits to such a department.

This lack of educational facilities in teaching institutions explains in part why many physicians secure their information on physical therapy from courses fostered by commercial interests, and why more progress has not been made in developing the methods among practitioners.

The Council on Physical Therapy of the American Medical Association (1) and some of the physical therapy societies (2) have taken the first steps for the practical education of the physician. The presentation of lectures and clinics to the county medical societies and meetings of the associations, which are given as preliminary instruction in the subject, marks progress in the advancement of this important branch of therapeutics.

The physician who does not himself wish to use physical therapeutics, but prefers to send his patients to specialists or clinics doing this type of work, is also more interested than formerly. Evidence of this is seen in the growth of physical therapy clinics and hospital departments during the last five years. Frequently the referring physician has not had the opportunity to acquaint himself with the possibilities of physical therapeutic practice. He often looks for results which are not possible from any type of therapy. If a better opportunity for gaining information were provided, such a situation would be less frequent. To overcome such difficulties a consultation is often helpful in order that the physical therapist may discuss the possibilities of treatment with the referring physician, and at the same time acquaint himself more fully with the problems confronting the physician. It frequently happens, however, that the physical therapist becomes so engrossed with the details of his own work that he loses his perspective and exaggerates the importance of the measures in which he is interested.

It has been observed that an opportunity for education of both the staff and the physical therapist will be presented if the latter will participate with the staff on visits to routine medical and surgical cases. This affords an opportunity for an interchange of ideas and tends to more hearty co-operation on the part of both groups.

The field of physical therapy has developed so rapidly that much more attention has been paid to the instruction of the undergraduate medical student than of the practising physician. Four years ago the announcements of medical schools and hospitals (3) indicated that only eighteen medical schools were providing courses in physical therapy, although nineteen others were giving time to the work in other courses. To-day there are only a few that do not make some provision for the instruction of their students in physical therapeutic measures. Not only is the number of medical schools teaching physical therapy increasing, but the courses are being extended and the quality of the instruction is being improved.

The teacher of physical therapy is not aided by the extensive background of experience and investigation which has been accumulated in other fields of therapeutics. Because of this condition it is most important that he select carefully the material which he places before his students. This must be scientific, compatible with other forms of medical practice, and of practical value. Instructors must also be continually searching for important and new investigations, which are constantly being reported, so that the present inadequate evidence relating to some of the physical therapeutic agents may be amplified. Most medical courses do not permit the expenditure of much time on physical therapy; therefore, the instruction is not commensurate with that given to subjects of equal importance, nor sufficient to ground the student in the fundamentals.

The material to be given the student and the location of the course in the curriculum are questions upon which few teachers of physical therapy seem to agree. Many schools have simply added physical therapeutics to the general course of therapy, while others furnish an optional course in the clinical years. Some few have taken the step of introducing a required course, with further work as an elective. One of the difficulties found when physical therapeutic methods are mixed with others or when the course is placed in the last year is that the students are not interested in the physics and applied physiology, but wish to learn only the technical procedures. It is obvious that without first learning the fundamentals the technical knowledge will be of little value.

Possibly the best arrangement at the present time is a short required course in the sophomore year and further electives in the clinical years (4). A part of the foundation for physical therapy can be laid in the pre-medical school years. Instruction in the physics of radiation, electricity, and the general properties of matter should be presented in such a way as to be more applicable to the future needs of the student of medicine. A short course during the sophomore medical year is very desirable. In this instruction period the physical principles as they apply to physical therapeutics should be reviewed and followed by studies of the physiological action of the agents. Courses in the clinical years should likewise be provided. It is advisable at this time to teach the practical application, with most emphasis placed upon the therapeutic action and indications for treatment. Instruction in technic should also be given to the students in groups of four or six, but it should always be secondary to the study of clinical indications and effects. The object of such courses is not to train physicians to be technicians, but to give them a knowledge of the therapeutic principles.

Because of the amount of time required for the purely technical work the actual application of physical therapeutic measures cannot be carried out on a large scale by the physician without adequately trained assistants. The training of competent technicians is, therefore, a matter of considerable importance (5). Many institutions have started courses for the training of physical therapy technicians, but few have the facilities for providing a complete and well rounded training. It is only in teaching institutions where instruction in the basic sciences can be combined with practical application that technicians can receive the most satisfactory training.

The educational standards for technicians set forth by the American Medical Association (1) and the American Physiotherapy Association require that the students have special preliminary training in the fields of nursing, physical education, or some allied activity. A number of the larger teaching institutions will admit only students who have successfully completed courses of nursing or physical education in recognized schools.

The course itself includes instruction in anatomy, physiology, pathology, and physics, as well as the technic of physical therapeutic application. A total of twelve hundred theory and practice hours is suggested, more than half of which are to be devoted to the theoretical work. At the present time only a few schools are able to meet these requirements, but it is encouraging to note that others are expanding their curricula so that their courses provide better training.

Thorough education of technicians will provide trained assistants in hospital departments and large clinics, but it will not supply the type of assistants required by most physicians in private practice. They should be able to secure an assistant trained

in the various types of laboratory work as well as in the technic of physical therapeutic methods. Since it is the practising physician who will do much of the physical therapy in the future, the training of this type should not be neglected.

SUMMARY

In this paper three lines of educational activity have been discussed: The first deals with providing educational facilities for the physician and is most pressing; the second, which concerns education of undergraduate medical students, indicates that progress is being made; the third, relating to activities in the field of technical training for assistants, points out that the present methods are meeting the needs of only a small part of the profession.

REFERENCES

(1) Council on Physical Therapy: Education in Physical Therapy. Jour. Am. Med. Assn., Feb. 8, 1930, XCIV, 407.
(2) Program of the American Congress of Physical Therapy, St. Louis, Missouri, September, 1930.
(3) Colwell, N. P.: Physiotherapy in Medical Schools and Hospitals. Am. Med. Assn. Bull., October, 1925, XX, 195.
(4) Warthin, Aldred S.: The Teaching of Physical Therapy (editorial). Ann. Clin. Med., February, 1927, V, 818.
(5) Peck, Willis S.: Education in Physical Therapy. Physiotherapy Rev., September-October, 1930, X, 422.

SUGGESTED ARTICLES OF INTEREST

1. Teaching of Physiotherapeutic Measures. W. H. MacCraken. Am. Jour. Electrotherapeutics and Radiology, June, 1925, XLIII, 213.
2. Some Teaching Courses in Physical Therapy (Report of Committee on Education in Physical Therapeutics, American Electrotherapeutic Association). J. C. Elsom, F. B. Granger, W. T. Johnson, E. N. Kime, and A. B. Hirsh. Physical Therapeutics, September, 1928, XLVI, 438.
3. Vital Problems in Teaching Physical Therapy. J. C. Elsom. Arch. Phys. Ther., X-ray, Radium, July, 1928, IX, 298.
4. Laboratory Methods in the Teaching of Physical Therapeutics. W. H. MacCraken. Am. Jour. Electrotherapeutics and Radiology, November, 1925, XLIII, 404.
5. The Study of Physiotherapy as a Vocation. Lucile Grunewald. Physiotherapy Rev., October, 1928; December, 1928; February, 1929; April-May, 1929; June, 1929.
6. The Problem of Teaching Physical Therapy and the Management of Hospital Departments: A Symposium. Norman E. Titus, *Chairman;* J. C. Elsom, F. H. Ewerhardt, Disraeli Kobak, Edwin N. Kime, Joseph E. G. Waddington, J. S. Hibben, Albert F. Tyler, George B. Lake, and Albert Bachem. Arch. Phys. Ther., X-ray, Radium, September, 1930, XI, 455.
7. The Teaching of Physical Therapeutics to Undergraduate Medical Students. Frank Hammond Krusen. Jour. Assn. Am. Med. Colleges, March, 1930.
8. Education in Physical Therapy. Edwin N. Kime. Physical Therapeutics, April, 1930, XLVIII, 202.

BIOPHYSICAL PRINCIPLES OF PHYSICAL THERAPY[1]

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PHYSICAL therapy utilizes the transfer of energy in one form or another to the human body in order to influence a pathologic condition either locally or generally. Such a transfer of energy takes place all the time under normal conditions and, if increased beyond certain limits, leads to the death of the individual. This refers to heat as well as to radiation and electric currents. It is, therefore, evident at once that whether a beneficial or detrimental effect is produced depends upon the quantity of energy applied as well as upon the quality. Unless the energy is measured in a proper way and unless we have found out how much is needed to accomplish the desired effect in the individual, we cannot expect to obtain good results. We have, then, from the outset two problems, one purely physical and the other one biological. Neither one of these should be neglected. It seems, therefore, that an intimate cooperation between physicists and physicians should lead to the best results.

From the physical point of view the agents used can be analyzed in a satisfactory way and the quality as well as the quantity of the energy applied may be determined. To find out in detail just what effect the treatment has on the biological object is, however, impossible. The best we can do is to study certain physical or chemical components of the animal or human being or certain functions and note to what extent they change with the treatments. So many more or less uncontrollable factors enter in, however, that even those simple changes we observe may be incidental instead of direct consequences of the applied energy. A statistical method is usually needed to give us information about the effects. It is this complicated biological aspect which sometimes makes the physician neglect the physical measurements or consider them unnecessarily accurate. The physicist, on the other hand, may sometimes go too far and prepare to make elaborate determinations where less accurate measurements would facilitate the biological experiment and lead to satisfactory conclusions. However, as a rule, we can state that detailed quantitative knowledge of the agent one uses is necessary for experimental work as well as for proper routine treatments. The forms of energy we shall consider here are electric currents, electromagnetic radiation, and heat.

RADIATION

When radiation is used for treatments it is important to know what kind of rays are present in the beam. The most useful theory at the present time is that the rays consist of electromagnetic waves moving with great velocity. The wave length defines the radiation. Any electromagnetic radiation can be spread out into a spectrum and each part of the spectrum is represented by certain wave lengths. The only satisfactory way of defining the radiation is by its spectral distribution. The first fundamental established fact which should be remembered is that all electromagnetic radiation is transported with the same velocity through a vacuum. This velocity amounts to about 3×10^{10} cm. per second, a constant which usually is designated by the letter c ($c = 2.9986 \times 10^{10}$ cm./sec.). The very simple relation $c = \nu\lambda$ states that the velocity is equal to the wave length (λ) times the frequency ν. It, therefore, does not matter whether the radiation is defined by the wave length or by the frequency, as the

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value of one of these quantities can be easily calculated when the other one is known. The spectrum has been divided up into certain large ranges. Thus rays from radium occupy the region 0.005 to about 0.5 Ångström unit (Å.U.)[2]; roentgen rays used in therapy 0.06 to 5 Å.U.; roentgen rays and ultra-violet radiation too easily stopped by air to be considered for treatments 5 to 2,000 Å.U. Ordinary ultra-violet radiation 2,000–4,000 Å.U. (200–400 mμ); visible radiation 400–800 mμ; infra-red radiation 800–100,000 mμ; radio and wireless rays 0.1 mm.–50,000 meter γ-rays and roentgen rays are usually considered separately and adequately and will not be taken up in detail here. Ordinary ultra-violet and infra-red rays belong definitely to the physical therapy field and will be referred to in the following discussion.

Absorption and Measurements.—The rays assert an effect only when all or part of them are absorbed; that means, when some of the radiant energy is changed into some other form of energy. When visible radiation strikes a black surface most of the energy is transformed into heat. The infra-red rays are changed into heat with especial ease, and that is why they sometimes have been called "heat rays." This is, however, a very poor nomenclature, as radiation is one form of energy and heat another form.

A very satisfactory way to measure the intensity of radiation is to let a narrow beam strike a blackened metal surface and thus be transformed into heat. The amount of heat produced can then be measured in one way or another. If the blackened surface is at the junction of a thermocouple, an electric potential is set up and an electric current may be produced which can be measured by means of a sensitive galvanometer. If the rays have been spread out to a spectrum by means of a spectroscope before they strike the thermocouple, the intensity can be determined for each wave length. This method of measuring radiation can be used throughout the whole range referred to here. Rays of short wave length (ultra-violet and part of the visible) liberate electrons when they strike a metal surface. This property can be utilized to measure them by means of a photo-electric cell and a galvanometer, a rather simple method which is used to a great extent. It must be kept in mind, however, that the efficiency varies with the wave length and the photo-electric cell must be calibrated for the part of the spectrum for which it is going to be used. Special care must be taken because this type of instrument may change its sensitivity with time, and recalibrations are, therefore, required. The cadmium photo-electric cell can be employed without the use of a spectroscope to measure the intensity of the radiation in the ultra-violet of the region effective in producing an erythema as it has a selective sensitivity in this region. The cell must, of course, be standardized and should be rechecked regularly (1). The color change produced by ultra-violet radiation in a methylene blue solution has also been recommended for determination of dosage. It must be remembered that a slight change in pH as well as the presence of a small impurity may have a pronounced effect on such a color change. Other chemical reactions may be influenced in a similar way. Special precaution must, therefore, be exercised if they are used to measure dosage.

The primary effect of the radiation on tissues can take place only where the rays are absorbed. Careful measurements have led to the conclusion that so-called far infra-red rays longer than about 1,400 (2) mμ are absorbed intensely by water and that they are practically completely absorbed by a few millimeters of tissues. Near infra-red and visible radiation are more penetrating, the maximum penetrabil-

[2] 1 cm. = 10 mm. = 10,000μ = 10,000,000 mμ = 100,000,000 Å.U. = 10^8 Å.U.

ity being around 1,200 mμ. Measurements have been made of the penetration through the cheek of a full grown person. According to Danforth, 20 per cent penetrates the cheek at this wave length (3). The tissues are quite opaque to ultra-violet radiation, and, on the whole, the more so the shorter the wave length. Between 240 and 310 mμ they are so easily absorbed that practically nothing passes through the skin. The direct action of this important zone, therefore, undoubtedly is limited to the skin itself unless the underlying tissues are denuded. Some recent biological experiments by Miescher (4) indicate that a thickness of 9μ of stratum corneum reduces the intensity of this radiation to one-half, and one of 90μ to about 0.1 per cent. It is interesting, too, that the amino-acids with a phenol ring, and, consequently, most proteins, have an absorption band around 280 mμ, and that hemoglobin has several absorption bands in the visible region as well as an intense one in the region around 400 mμ.

Action.—It is well known that infra-red and visible radiation heat the tissues. Therefore a great portion of these radiations must be transformed directly into heat: whether they have any other effect has not been definitely determined as yet. As they are fairly penetrating, they carry the heat into the tissues to a certain extent and this may be of great importance, as, *e.g.*, pointed out by Sonne (5) (destruction of toxins, etc.). The shorter rays may also be transformed into heat to a certain extent, but they evidently also have other actions. The photo-electric effect undoubtedly leads to chemical changes. This is particularly evident in the region of from 240 to 310 mμ, which produces skin erythema, activates ergosterol, etc. The pigmentation of the skin is a later effect of this radiation, but may, according to Uhlmann (6), also be produced by waves around 313 and 366 mμ. As is noticed from this, erythema and pigmentation are not as closely correlated as was usually assumed, and the latter is not just simply a consequence of the former. It is well known that exposure to erythema-producing ultra-violet rays makes the skin less sensitive to subsequent exposures, but it has been under discussion how this protection is brought about. Undoubtedly, the pigmentation contributes to a certain extent to this protection, but Miescher (4) has on the basis of a series of convincing experiments concluded that the main factor is the thickening of the stratum corneum. This seems very plausible if it is true that 9μ of the layer absorbs 50 per cent of this type of radiation. If, *e.g.*, the stratum corneum is thickened from 10μ to 30μ (as he found in one experiment), about four times as much exposure would be required to produce the same reaction as before.

Insofar as light therapy is concerned it is evident that it can be very effective. It is also clear from the previous discussion that the action depends upon the spectral distribution of the radiation used. Both qualitative and quantitative measurements are required in order that the best results may be obtained. A great amount of research is needed in order to determine just which type of radiation is best for a certain condition. The extreme difficulty in determining the "dose" given an individual during a treatment as a consequence of the variation in thickness of the stratum corneum should never be lost sight of.

ELECTRIC CURRENTS

Different types of electric currents have different effects upon the human body: the first requirement, then, is to differentiate between the various types. An electric current means movement of very minute electrically charged particles. In a metallic conductor the current is carried by negative electrons; in an electrolyte by an equal number of positive and negative ions. The current can be either direct or alternating. The

particles which transport the current do not change the direction of movement in a direct current. In an electrolyte, *e.g.*, the positive ions are moving in one, and the negative ions in the opposite, direction continuously. In an alternating current the direction of the movement changes and the number of times per second the particles return to their first direction is referred to as the frequency of the current.

If the current does not change its intensity with time it is referred to as a constant direct current. The intensity of such a current is determined by the resistance of the conductor and the potential difference between the ends of this conductor. The practical unit for the resistance is the ohm (Ω), for the potential difference the volt (V), and for the current the ampere (A). If these units are used, the simple relation holds $A = \frac{V}{\Omega}$ (Ohm's law). If a current of one ampere passes through a metallic conductor, it means that 6.281×10^{18} electrons pass through the cross-section per second. Due to the resistance some of the electricity is transformed into heat and the amount thus transformed is equal to $0.24\ A^2\Omega$ calories per second (Joule's law). Slight fluctuations in the current do not affect these relations considerably if average values are taken. The simplest form of alternating current is the so-called sinusoidal, which changes intensity continuously and smoothly up to a maximum and down to zero again, then below zero to a minimum value, and then back to zero, and so on. One such complete change, as described, is called one cycle. Currents with almost any number of cycles per second, of any frequency, can be made. The most common is the 60-cycle current, available in most cities. The average value of this current at a certain cross-section is zero, as just as much current passes in one direction as in the opposite direction, and it, therefore, cannot be measured with a direct current meter. The effect is, however, proportional to the square of the current, and the square is, of course, always positive. The effective current is equal to the square root of the average of the square of the intensity. The A.C. is influenced by reactance and capacity as well as by resistance. These new factors are of greater importance the higher is the frequency of the current. The heat produced is, however, still $A^2\Omega$, if Ω is taken as the "effective" resistance through which the current A passes.

The faradic current consists of sudden impulses which last for a very short time, with longer intervals in between. The impulses alternate directions and are usually more abrupt in one direction than in the other.

Current through Tissues.—An electric current passes through the body in a way similar to that in which it goes through corresponding types of inanimate conductors. From a physico-chemical point of view, tissues can be regarded as made up of membranes and fluids. The membranes are very poor conductors, while the fluids are good conductors of the electrolyte type. The electricity is, therefore, transported by ions. If two resistances are in series, the same current passes through both; if they are connected in parallel, the current is divided between them in such a way that $\frac{A_1}{A_2} = \frac{\Omega_2}{\Omega_1}$. The greater portion of the current passes through the smaller resistance, but some goes through the higher resistance. If the two electrodes are applied to the skin at different parts of the body, the current has to pass both through the skin and the underlying tissues, these structures being in series. Most of the current passes straight through the soft tissues because the resistance there is low; some spreads out sideways, but as this portion of the current has a longer pathway, the resistance is

greater and consequently the density of the current is smaller. A very small portion passes through the bones, which offer much higher resistances than the surrounding soft tissues (resistance in parallel). The effective resistance of the tissues depends upon the type of current used: it is many times greater for D.C. than for high frequency current, while it has an intermediate value for relatively low frequency (*e.g.*, 1,000-cycle current).

Action of Current.—If a direct current passes through the body, negative ions will be moving steadily towards the positive electrode and positive ions to the negative electrode. Different kinds of ions will partake in the movement and cause chemical disturbances. It is, therefore, easy to understand that a heavy current of this kind causes severe injuries or death.

The machines used for application to patients of the direct current are, as a rule, constructed so that only a rather small current can be delivered—usually some few milliamperes are used. Where the electrodes are applied on the skin or in wounds, a polarity effect is noticed, due to the fact that negative ions are slightly concentrated near the positive electrode and positive ions near the negative electrode. When the D.C. is used for diagnosis or treatment, it is usually referred to as "galvanic current." It sometimes is used for so-called ionization therapy. Certain salts or salt solutions are placed under the electrodes so that either positive ions (metal ions) may be transported into the tissues from the positive, or negative ions (iodine, etc.) from the negative electrode. It must be kept in mind, however, that these ions do not move very far, because they soon reach a location with an abundance of other ions, which then will take over the rôle of transporting the current farther. The cell membranes also offer a hindrance to most ions.

Any sudden change in a current passing through the body produces stimulation of nerves and muscles in its path, the greater the change per unit of time the more intense the stimulation: such stimulation can, therefore, be produced by the sudden application or interruption of D.C. A low frequency current can also be used for this purpose. As the frequency is increased while the current is kept constant, the individual stimulations become smaller; at a certain frequency tetany will be produced. When the frequency approaches 10,000 the stimulation disappears completely, and at higher frequencies the only effect which so far has been established is the heating of the tissues.

DIATHERMY

The high frequency current is being utilized to a great extent to produce heat in the tissues, this type of treatment being referred to as "diathermy." A frequency of from 300,000 to 3,000,000 is used. Not much difference in effect or efficiency has so far been found, when the frequency has been varied between these limits. The heat is produced in the tissues through which the current passes, and is determined by the square of the current times the "effective" resistance, or by the current times the effective voltage: the current can easily be measured by means of the ordinary meters on the machines. The total effective resistance has to be measured for high frequency current, and that is a difficult thing to do, requiring a complicated arrangement of apparatus (7). The effective voltage can, on the other hand, be measured in a simple manner by means of a thermocouple voltmeter (8). This method of measuring voltage is as yet not used generally, but should be useful if one wants to know the total amount of heat produced in the body, or the "effective" resistance. The effective voltage is altogether different from the crest voltage, and there is no simple relation between them for the type of current produced in the ordinary diathermy machine.

The current the tissues can stand is, however, not dependent upon the total amount of heat produced but upon the temperature produced, a thing which varies from one place to the other, depending upon the density of the current, the specific resistance, and the specific heat of tissues in question, as well as upon the rapidity with which the heat is carried away. It will, therefore, be difficult to find a device which indicates which intensity of current should be used. Thermocouples can be placed under the electrodes and sometimes stuck into the tissues, and thus be used to determine the temperature at certain locations. Such a method can hardly be made practical for ordinary diathermy treatments. The amount of current per square centimeter of the smallest cross-section through which it has to pass still is the most practical indicator available to keep the temperature within safe limits. The upper limit of the density of the current depends to a certain extent upon the type of tissues, the blood circulation, the hydration or dehydration of the tissues, the physical condition of the surroundings, and the type of electrodes used. The path of the high frequency current through the tissues is similar to that of the direct current, but the effective resistance is very much smaller. The skin and subcutaneous fat still offer a relatively high resistance and are consequently heated up considerably, being in series with other tissues. Bones, on the other hand, are not heated much, in spite of their high electrical resistance, as a very small portion of the current passes through them. Most of the current passes through such of the soft tissues as are in parallel.

Diathermy can be used not only to increase the temperature locally but to increase the body temperature as well. It is then necessary, however, to reduce the elimination of heat from the body as much as possible in order to overcome the very effective temperature-regulating mechanism. By using large electrodes and about 3 amperes, and with the patient very well covered so that evaporation is small, the temperature may be raised to 106 or 107° F. in a couple of hours. This method of heating patients is preferable to other methods for the reason that it can be controlled so nicely, and one can be with the patient and watch him and study the effects. It is not practical for animal experiments, as it is difficult to keep the electrodes in place and it is necessary to shave the animals in order to get good contact. If, however, still higher frequencies, such as are utilized in short radio waves, are used, the electrodes do not need to be applied to the skin and the animal can simply be placed between two plates, forming a condenser (9), an arrangement which seems very suitable for this type of experiment and which already has been applied for some investigations.

HEAT APPLICATION

Two methods of applying heat to the body have already been discussed, *i.e.*, by transforming radiation and electric currents into heat inside the tissues. Locally, heat can, of course, also be applied by means of hot compresses, hot water bags, etc. If constant temperature is desired continuously for a day or more, a special arrangement is necessary. We have accomplished this by having a fairly large container in which water is kept at constant temperature by means of an electric heater and thermoregulator, and a circulating system by which this water is constantly kept flowing through a rubber bag placed on the patient.

Heat can be applied to the body by means of different types of baths. The body temperature can be raised by means of a hot water bath if all the body except the head is covered. Hot steam baths are undoubtedly the most effective in raising the temperature, as the cooling effect by evaporation both from the skin and from

the lungs is prevented. Dry hot air baths are, of course, very effective in producing perspiration, but, due to intense evaporation, the temperature of the body is kept much below the temperature of the air. Hyperpyrexia produced by means of external physical sources is sometimes referred to as "artificial fever." Would it not be better to reserve the name "fever" for diseases in which the temperature-regulating mechanism is disturbed in such a way that the temperature equilibrium is brought above 37° centigrade? Hyperpyrexia has long been used for treatments of certain diseases, but its effectiveness has not been generally accepted. New interest in it has been awakened with the introduction of modern devices which permit more perfect regulation of the temperature. Hyperpyrexia is, of course, injurious to a certain extent to the normal tissues and their functions, but it evidently is more harmful to certain bacteria and certain bacterial toxins as well as to malignant tissues. Therefore, the possibility exists that it may be effective in certain diseases if used properly. Necrosis of the tissues may result if the increased temperature is kept up for any length of time. Some experiments by N. Westermark (10) have shown that tissue necrosis can be produced in rats if the local temperature is kept at 44° C. (111.2° F.) for about three hours. The knowledge of the physiological, biochemical, and hematological effect of hyperpyrexia in contradistinction to fever is essential for further advance in this field. These effects are being studied now at several laboratories and some interesting findings have already been brought out. The effect on the blood of a temperature increase up to 106° and lasting for from three to five hours is not nearly so pronounced as that of fever. The pulse rate and the diastolic blood pressure are definitely increased, and the metabolism also seems to be increased. Such a treatment causes a loss of several pounds of fluid in form of perspiration, evidently releasing a great amount of bound water into free water and removing it through the skin. It is possible that the investigations of this type finally will lead us to definite conclusions concerning the effectiveness of heat treatments, as well as concerning the proper temperature and time to use them.

BIBLIOGRAPHY

(1) Dorno, C.: Strahlentherapie, 1922, XIV, 25.
Idem: Strahlentherapie, 1927, XXV, 351.
Pohle, Ernst A., and Sawyer, Ralph A.: Am. Jour. Roentgenol. and Rad. Ther., October, 1928, XX, 338.

(2) Coblentz, W. W., Dorcas, M. J., and Hughes, C. W.: Strahlentherapie, 1928, XXX, 170.

(3) Danforth, R. S.: Proc. Soc. Exper. Biol. and Med., January, 1930, XXVII, 283.

(4) Miescher, G.: Strahlentherapie, 1930, XXXV, 403.

(5) Sonne, Carl: Acta Medica Scandinavica, 1921, LIV, 336.
Idem: Acta Medica Scandinavica, 1922, LVI, 619.

(6) Uhlmann, Erich: Strahlentherapie, 1930, XXXV, 361.

(7) Hemingway, Allan: Radiology, February, 1930, XIV, 99.

(8) Idem: Quantitative Measurements of Diathermy Dosage. In press.

(9) Hosmer, Helen R.: Science, Oct. 5, 1928, LXVIII, 325.
Carpenter, Charles M., and Page, Albert B.: Science, May 2, 1930, LXXI, 450.

(10) Westermark, Nils: Skandinavisches Archiv f. Physiol., 1927, LII, 257.

CLINICAL APPLICATIONS OF ULTRA-VIOLET RAYS[1]

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A HOSPITAL to be recognized as modern must be so equipped that the sick may benefit by the latest discoveries in medical science. Among the most important advances in modern therapeutics is the proper use of physical agents. The physical agents of the greatest use to the general practitioner are heat, light, water, massage, and exercise. In the use of these agents by the general practitioner it is important that they be on definite prescription, as are drugs, and that they be employed for long periods daily, for which some arrangements must be made for their use at home. This has been considered elsewhere by one of us (*22*), and in this short article it is desired to consider one physical agent used today in most hospitals, namely, ultra-violet radiation.

The lack of standardized methods of measurement of dosage, of careful records, and the follow-up of cases in this field is deplorable. If clinical results are to mean anything, these defects must be corrected. Instead of reporting a few cases benefited by ultra-violet radiation from a certain lamp with no standardized dosage given, groups of cases in hundreds or thousands should be studied. The clinical department referring the case to the physical therapy department should make the preliminary examination and diagnosis. The physical therapy department should have all lamps calibrated by such methods as suggested by Pohle (1) or Coblentz (*2*). The calibration of the lamps should be checked every month, for even if lamps were standardized at the time of their manufacture, serious variations would occur with the aging of the lamp and variable conditions of usage. The dose should be such that it could be duplicated in another department. The results should be judged by the clinical department referring the case. The physical therapy department should keep careful records of the cases and report them with the clinical department. No case should originate in the hospital physical therapy department, but this department should have the entire responsibility of prescribing the treatment.

The therapeutic use of ultra-violet light in dermatology has recently been coming to the front because of more active and more accurate research. At present its use tends to be more as an adjunct method of treatment rather than a specific one.

In *psoriasis* some cases will clear up remarkably well under ultra-violet radiation, while others will fail to respond or even be made worse. In persistently recurring cases ultra-violet light may be used liberally, whereas repeated X-ray treatments are liable to produce permanent skin changes. Ultra-violet is being used to prevent the recurrence of lesions by having the patient use the lamp periodically at home, using a small dose, with the maintenance of slight pigmentation. In general, the superficial, slightly infiltrated forms, especially in fresh eruptions, respond better than long-standing thick plaques. Response is also better in those cases which have not had a previous attack, and in which the onset has been rapid. A second degree erythema is necessary, and in the treatment of thick patches a water-cooled lamp with compression may be used to shorten the time. Goeckerman (3) has reported on the use of crude coal tar ointment and ultra-violet in psoriasis, the effect being that of a sensitization of the lesions to the light.

In *alopecia areata* of recent origin an active hyperemia may be produced by inten-

[1]Read for the authors by John S. Hibben, M.D., of Pasadena, Calif., before the Radiological Society of North America at the Sixteenth Annual Meeting, at Los Angeles, Dec. 2-5, 1930.

sive doses of ultra-violet light; no improvement can be expected without a hyperemia. Hyperemia produced by irritants, where the destruction is not too great, will produce equally good results. In the old cases, especially of the universal type, ultra-violet should be tried even though the prognosis is poor. It is of utmost importance in the prognosis of these cases to make a correct diagnosis. In cases in which scar formation is the result of a disease a bald spot results from permanent destruction of the hair follicles, as in pseudopelade of Brocq, and no results can be expected.

In seborrheic alopecia, also, there is a tendency to a degeneration of the hair follicle, and ultra-violet light may produce a fine fuzz which does not develop further, and which tends to fall out. It has been shown that the action of ultra-violet in alopecia is not specific and that results are due to reorganized nervous and vascular tone.

In *acne vulgaris* the best result with ultra-violet light is obtained in the acute stages, where there are a small number of comedones, with some acute inflammation and a rather large amount of oily secretion. Pustular lesions are absorbed rapidly under bi-weekly doses; a first or second degree erythema is recommended by Andrews (4). The treatment of acne with ultra-violet is likely to be very slow. Patients often object to repeated heavy doses of ultra-violet light to the face. Other factors in the disease, such as endocrine disturbances, chronic indigestion, poor nutrition, etc., should be corrected.

In *tuberculosis of the skin,* such as lupus vulgaris, the production of a second degree reaction, locally, produces improvement. The clearing up of systemic tuberculosis also is a factor in the treatment of local skin tuberculosis. Reyn (5) says that a permanent recovery with slightly visible scars was manifest in 90 per cent of 104 cases of lupus, while an intensive, but only local, treatment proved far less effectual. In this connection it is well to remember that in the presence of advanced pulmonary tuberculosis, or tuberculosis of the pleura, ultra-violet light must be used with caution.

Pityriasis rosea is a systemic disease whose marked symptoms are large fawn-colored lesions distributed over the trunk, together with itching, which is worse at night. The disease, of course, is harmless and self-limiting. A dose sufficient to produce exfoliation can be used to remove the lesions and to relieve the itching, leaving in their place erythema and an exfoliation, producing the discomfort of a severe generalized sun-burn. For this reason many patients prefer to have the disease run its course without the treatment.

In the *superficial fungus infections* of the skin, such as tinea versicolor, a prompt cure can be obtained by removing the organism as well as the superficial layers of the skin. This exfoliation is necessary as the fungus inhabits only the superficial layers of the skin. Keratolytic ointment, such as one-half strength Whitfield ointment, or a solution of 10 per cent sodium hyposulphite, will produce equally good results without an erythema. In *ringworm* of the feet, the difficulty of exposure of the area between the toes to ultra-violet rays is overcome by the use of an ointment. Ringworm of the scalp is better treated with agencies which will cause the temporary epilation of hair, as ultra-violet light does not penetrate sufficiently.

In *impetigo,* better results can be obtained by rigid local cleanliness, and the use of antiseptics such as 4 to 10 per cent ammoniated mercury ointment. While it has been demonstrated that the shorter wave length ultra-violet has bactericidal properties, the difficulty in its use is the lack of penetration of sufficient quantities of these shorter rays to become effective. The killing of the few organisms on the surface is not of much practical importance. An inflammatory re-

action, however, produced by a second degree erythema, does seem to produce local resistance and thus some slight improvement. This same statement might be made for other infections of the skin such as pyodermia, ecthyma, etc.

In *erysipelas*, Ude (6) has reported the use of ultra-violet in 91 patients, followed by as good results as could be expected, with other accepted methods of treatment, including roentgen radiation and antitoxin. With the use of ultra-violet, he points out that the technic is simple, inexpensive, devoid of danger, requires only one treatment, is readily available in practically all communities, and that the results are comparable to those of any other method. Becker points out the exceptionally high mortality of infantile erysipelas. In the German hospitals, according to Schlieppe's report (1923) of infants under one year old stricken by erysipelas, 78 per cent died. In America, an 80 per cent mortality was reported in 1927. Becker reports that with from one to one and one-half erythema doses at the German hospital clinic at Bonn, by the use of ultra-violet light 87 per cent were cured and that only one child died, which death was due to general infection complicated with peritonitis and bronchial pneumonia. These results are somewhat startling. While exposure to ultra-violet rays in erysipelas has been severely criticized by some, it deserves further study, and additional work will have to be done before a definite stand can be taken on the subject. It must be remembered, however, that other methods of treatment are far from remarkable.

The theory that ultra-violet radiation might be used to lessen the effect of a massive dose of X-ray, intentionally or otherwise given, we believe has been definitely disproven by MacKee (7). Ultra-violet might improve chronic X-ray ulcers by an improvement in the circulation and by a stimulation of granulation tissue, but otherwise is contra-indicated. Experimental studies on the combined effects of roentgen and ultra-violet rays by Pfahler *et al* (8) show that the ultra-violet would not prevent roentgen-ray dermatitis in many of the rabbits on which they experimented. On the contrary, the ears which received combined treatment with ultra-violet and roentgen rays showed a more severe reaction than the control ears. These control ears received the same amount of roentgen-ray treatment, producing a maximum reaction in which ulceration and a sloughing off of the ears occurred.[2]

Contra-indications to ultra-violet therapy might include high or continued fever, marked activity of lesions, advanced cardiorenal diseases, acute pulmonary tuberculosis, smallpox, and hyperesthesias to light in such rare conditions as hydroa vacciniforme, hydroa æstivale, and xeroderma pigmentosum.

The effects of the lack of standard methods for measuring dosage of ultra-violet radiation are illustrated by the reported results of ultra-violet radiation on the blood. In a series of 200 new-born infants short exposures of ultra-violet radiation, according to Sanford (9), increased the hemoglobin content and number of red blood cells to a slight extent in an average number of cases, and there was a rapid return to normal. Short exposures to ultra-violet radiation increased the hemoglobin content and the number of red cells to a greater extent in cases in which these elements were lower than normal, and they tended to remain normal. In contrast to this report a recent careful study (10) of forty children showed that ultra-violet radiation had no specific effect on the blood. In respect to these experiments and many similar ones, it would be impossible for another group of investigators to duplicate the dosage, as apparently neither the quantity nor quality of the radiation was sufficiently

[2]See also Pohle, F. A., and Wright, C. S.: RADIOLOGY, April, 1930, XIV, 351.

measured, nor is it recorded that variations of the individuals were considered. Thus the use of ultra-violet radiation in secondary anemias is still in the experimental stage.

Ultra-violet radiation has a definite value in the treatment of ophthalmological diseases. In co-operation with our Department of Ophthalmology, we are trying to secure clinical data on this subject.

Corneal ulcers respond well, for which a concentrated form of ultra-violet radiation should be used. In determining our dosage we used a mercury quartz water-cooled lamp on the conjunctiva and cornea of six rabbits. With this lamp at a distance of about one inch it took on the average forty seconds to secure a superficial cell destruction such as could be detected by the use of fluorescin. Therefore, we give our patients only a 30-second dose at the same distance. Local treatment is of benefit in corneal ulcer, tuberculosis of the cornea and conjunctiva, trachoma, and blepharitis. Herpetic lesions show the most marked effect of such treatment. General body radiations are of benefit in phlyctenular keratitis and in ocular conditions due to tuberculosis (11).

Ultra-violet radiation has a definite value in the treatment of wounds. The exposure should be made at every change of dressings and increased in accordance to the patient's tolerance. In the after-treatment of electrical burns, healthy granulations are encouraged by the judicious use of ultra-violet radiation, according to Fisher (12). Ultra-violet radiation is a valuable adjunct in the preparation of infected granulation tissue for skin grafting. For an infected or a sloughing wound, a continuous hot, wet dressing is used, and changed daily. When these measures have insured an adequate blood supply, ultra-violet radiation is employed in doses sufficient to render the granulations red, vascular, and free from exudates. The dose should be such as to produce a mild erythema on the normal skin, and increased if the wound is not properly influenced. When the granulation tissue has become a firm bed of beefy red —a non-infected area—with a line of growing epithelium at the edges, conditions are right for skin grafting.

In active rickets, cod liver oil, viosterol, and ultra-violet radiation are generally accepted as specific agents in the prevention and cure in infants. Viosterol is of advantage because of its concentration. Ultra-violet radiation doubtless produces a variety of physiologic effects, including influences on the blood and circulation, that remain to be carefully evaluated. The main difficulty is the lack of information of the amount of ultra-violet radiation needed. A combination of cod liver oil, viosterol, and ultra-violet radiation seems most desirable at present. Their relative merits are under investigation. Gerstenberger (13) has been using only one exposure of ultra-violet radiation weekly to secure a mild erythema, and says he secures the same results as with larger amounts.

The dosage of ultra-violet radiation in infants with tetany was recently studied (14), and it was found that the dosage given by Gerstenberger as sufficient to cure rickets could not be relied on to cure tetany. Here again is demonstrated the disadvantage of the lack of standardization of dosage. Gerstenberger used the erythema unit of Rost and Keller and the investigators in the dosage in tetany used the oxalic acid-uranye sulphate method to measure the intensity of ultra-violet radiation. They found the limit of optimal dosage to be between eight and thirty-eight oxalic acid units and used daily doses.

The susceptibility to common colds has been reduced 40 per cent according to Maughan and Smiley, of Cornell (15), in a series of experiments on college students over a period of several years. This has not been confirmed by like experiments else-

where, but our experience leads us to believe that ultra-violet radiation plays an important rôle in the prevention of bronchitis. Sunshine is the best source of this radiation, but artificial sources must be used in the winter months in cold climates. Here, again, is a subject for clinical investigation as to the amount of radiation needed and for a control series of cases.

The general treatment of tuberculosis by ultra-violet radiation is not placed on a proper scientific basis. The main reliance in tuberculosis is still in rest, hygiene, and diet, but ultra-violet radiation is one of the most important adjuvants in the treatment. Sunlight is still the best source of ultra-violet light. Mayer (18) believes that artificial sources of light are not to be relied upon as important aids in the treatment of pulmonary tuberculosis. Even sunlight in pulmonary tuberculosis leaves much to be desired. Also, the dangers are such as to make this form of treatment hazardous unless carried out under expert supervision. So far as cases of pulmonary tuberculosis are concerned, nothing but failure will result if cases are treated when the patient's temperature is 100° F. Treatment should be stopped then, and the patient be kept at rest in bed. Treatment can be resumed when the temperature falls to normal, and the dose must be lowered. It is probably better to under-expose the patient than to over-irradiate him.

The aim of ultra-violet radiation therapy is to find the part of the radiant energy spectrum which is specific or, at least, best adapted for use in tuberculosis. Some work has been done along this line by Phelps (16), and although it has not been confirmed, it is at least a step in the right direction. He states that the wave length band lying between 320 and 380 millimicrons was studied both clinically and experimentally and was found to be active. The chief effect is an acceleration of the processes of repair which may or may not be specific for tuberculosis, but which is essential in the retention of function. It is an indirect effect, general rather than local. Longer exposures can be given if the erythema and tan-producing rays, 300 to 320 millimicrons, are of small quantity or absent. Erythema and pigmentation, therefore, are of no use as a basis of dosage given.

Sunlight is the treatment of choice for bone and joint tuberculosis, graduated exposures of the body usually being made, according to the method of Rollier (19), together with the agencies of diet, hygiene, and necessary surgical measures. General exposures are used, with additional local exposures over the area of disease. In bone and joint tuberculosis, a weight chart should be kept and watched carefully as this is one of the most important guides to the progress of the cases. X-ray films, with at least two views of the joints, should be made at intervals of three months. Proper orthopedic measures should always be taken.

In laryngeal tuberculosis, general body radiation should be combined with suitable local treatment. Strandberg (17), who has reported a most complete study of 203 cases of laryngeal tuberculosis, employs a treatment consisting of increasing periods of general body radiation combined with other suitable local and general treatment. He reports cures in 113 patients, or 55.6 per cent.

With proper care and conscientious supervision, the results obtained by ultra-violet radiation in tuberculous peritonitis and intestinal tuberculosis are quite encouraging. The greatest caution is necessary in the matter of exposure, and the method of gradual body exposures, starting at the feet, after the method of Rollier, should be followed with either natural or artificial radiation. The area of exposure and the time are gradually increased until the patient receives a general body radiation with additional local exposure of the abdomen.

In lymphatic tuberculosis, we have ob-

tained excellent results with ultra-violet radiation, and our experience agrees with Mayer. He says: "Tuberculous lymph nodes may be seen clinically in three different stages. In the first stage, exposure to light is followed by an inflammatory reaction, with slight pain, tenderness, and swelling. In the majority of cases the inflammation subsides, and the lymph node finally heals. About 30 per cent of these appear to the writer to show no tendency to heal under light alone; but with X-ray irradiation, in addition, a large number of these also will improve. In the second stage of caseation, ultra-violet light exposures alone will frequently bring about resolution. When softened lymph nodes reach the stage of fluctuation, aspiration or incision is necessary, and then ultra-violet radiation is most effective. In the third stage, excellent results are obtained in clearing up sinuses of long standing, but occasionally X-ray exposures may have to be combined with light treatment for complete healing to take place. Local irradiation of the sinus area should be made, in addition to general irradiation of the body. In cured cases exposures have varied from three to eight months."

Ultra-violet radiation has a place in the treatment of arthritis. Its influence is not specific, but it has a definite value when the patient has a secondary anemia or is suffering from a lack of sunlight due to confinement in bed. All our arthritic cases receive artificial ultra-violet radiation in the winter months and are instructed in sun baths in summer. Again dosage has not been determined.

We have been co-operating with the Department of Medicine in the use of ultra-violet radiation in asthma. Unger (20) of this Department says: "For about three years we have been using ultra-violet light as an accessory method of treatment. We believe it helps as a tonic and it seems to be specially valuable in the under-nourished. We believe that it has no specific value, yet our results have certainly been improved since we adopted its use."

Recently we have tried to estimate the blood calcium in fracture cases with non-union, but in no case were we able to show a deficiency of blood calcium. Swart (23) recently showed that irradiated ergosterol given by mouth to rabbits did not increase the rate of healing or the amount of callus formed in fractures of the tibia and fibula. Murray (22) says that "fractures always heal, unless there is a mechanical bar to tissue growth." The healing is accomplished as with wounds elsewhere by the growth of granulation tissue. This granulation tissue is derived from the wounded soft parts of the bone-periosteum, endosteum, and the areolar tissue about the vessels in the narrow cavity and elsewhere.

The source of calcium for this calcification is dead, autolyzed bone at the site of fracture, and not the blood stream. Vascular changes probably induce local tissue pH changes, which may strongly influence precipitation of calcium salts from solution or colloid combination or ferment activities on large radicles of organic calcium salts. Given tissue death, a local calcium source, a vascular status producing the proper pH, and granulation tissue, bone will form without the presence of any bone cell. Bone as a calcium source can be experimentally replaced by both inorganic and organic salts of calcium. Either precipitation or ferment-splitting activity may be responsible for the calcium deposition; the latter seems the more probable. Bone and soft-part circulation are of prime importance in the process of calcification of fracture healing and should, therefore, be prime objects of attention early in the bone-healing process. The time to use elevation, heat, massage, diathermy, and active exercise is then, if possible; it is much more important than later in the course. Mouth administration of calcium and phosphorus and similar

drugs is ineffective. If calcium is needed, it must be supplied locally and not *via* the blood stream in any individual whose general calcium metabolism is normal. From the above experiments and our experience, therefore, we believe that ultra-violet radiation will not influence the union of fractures.

In concluding this brief discussion of ultra-violet radiation there are several points that apply to the use of all physical agents which we wish to emphasize: First, the urgent need of a standardized dosage; second, the use of these agents on a definite written prescription by a physician and not by a technician with generalized directions by a physician; third, these agents are only adjuncts and must, therefore, be used as aids to other medical or surgical treatment.

BIBLIOGRAPHY

(1) Pohle, Ernst A., and Sawyer, Ralph A.: Physical and Biological Problems in Heliotherapy: III.—The Calibration of the Mercury Vapor Lamp in Reproducible Units for Clinical Purposes. Am. Jour. Roentgenol. and Rad. Ther., October, 1928, XX, 338.

(2) Coblentz, W. W.: Instruments for Measuring Ultra-violet Radiation and the Unit of Dosage in Ultra-violet Therapy. British Jour. Radiol., August, 1930, III, 354.

(3) Goeckerman, W. H.: The Treatment of Psoriasis. Northwest Med., May, 1925, XXIV, 229.

(4) Andrews, George C.: Diseases of the Skin. W. B. Saunders Co., Philadelphia and London, pp. 446, 447.

(5) Reyn, Axel: Du Traitement du Lupus Vulgaire et des Autres Formes de la Tuberculose par la Lumière Artificielle (Finsenlight Treatment in Tuberculosis). Jour. de Radiologie et d'Electrologie, August, 1924, VIII, 337.

(6) Ude, Walter H.: Ultra-violet Radiation Therapy in Erysipelas. Radiology, December, 1929, XIII, 504.

(7) MacKee, George M., and Andrews, George C.: The Ultra-violet Ray as a Prophylactic against Radiodermatitis. Jour. Am. Med. Assn., Nov. 28, 1925, LXXXV, 1715.

(8) Pfahler, George E., Klauder, Joseph V., and Martin, James L.: Experimental Studies on the Combined Effects of Roentgen Rays and Ultra-violet Rays. Am. Jour. Roentgenol. and Rad. Ther., August, 1926, XVI, 150.

(9) Sanford, Heyworth N.: Effect of Ultra-violet Light on the Blood of New-born Infants: II.—Erythrocytes and Hemoglobin. Am. Jour. Dis. Child., January, 1928, XXXV, 9.

(10) Hoeffel, Gerald, and Lyons, Dorothy: Heliotherapy and the Peripheral Blood. Am. Jour. Dis. Child., September, 1930, XL, 484.

(11) Gifford, S. R.: Light Therapy in Ophthalmology. Trans. Am. Acad. Ophthalmology, 1928, p. 195.

(12) Fisher, Hart E.: Electrical Burns. Illinois Med. Jour., March, 1930, LVII, 201.

(13) Gerstenberger, Henry J., and Hartman, J. L.: Quartz-lamp Therapy in Human Rickets and Rachitic Spasmophilia: Efficacy of Single Weekly Exposures. Jour. Am. Med. Assn., Feb. 2, 1929, XCII, 367.

(14) Bakwin, Harry, and Bakwin, Ruth M.: The Dosage of Ultra-violet Radiation in Infants with Tetany. Jour. Am. Med. Assn., Aug. 9, 1930, XCV, 396.

(15) Maughan, G. H., and Smiley, D. F.: Further Observations on Control of Common Colds by Ultra-violet Rays. British Jour. Actinotherapy, September, 1930, V, 115.

(16) Phelps, W. M.: Specificity of Light Action in Tuberculosis. Jour. Bone and Joint Surg., April, 1930, XII, 253.

(17) Strandberg, O.: Heliotherapy and Artificial Light: Treatment of Tuberculous Conditions and Particularly Laryngeal Tuberculosis. Jour. Am. Med. Assn., May 19, 1928, XC, 1595.

(18) Mayer, Edgar: Clinical Application of Sunlight and Artificial Radiation, Including Their Physiological and Experimental Aspects, with Special Reference to Tuberculosis. Williams and Wilkins Co., Baltimore, 1926.

(19) Rollier, Auguste: Heliotherapy. Oxford Med. Publications, 1923.

(20) Unger, L.: Prognosis and Treatment of Bronchial Asthma, with Special Reference to Pediatrics. Illinois Med. Jour., October, 1930, LVIII, 270.

(21) Coulter, John S.: Physical Therapy from the Standpoint of a Practitioner. Proc. Congress on Medical Education, Medical Licensure, and Hospitals, Chicago, February, 1930.

(22) Murray, C. R.: Repair of Fractures. Minnesota Med., March, 1930, XIII, 137.

(23) Swart, Howard A.: The Effect of Irradiated Ergosterol on the Healing of Experimentally Produced Fractures in Animals. Jour. Bone and Joint Surg., April, 1930, XII, 360.

DISCUSSION

Dr. H. J. Ullmann (Santa Barbara, California): There is one point I wish to emphasize which was not spoken of in any of the papers. Any trained technician can give infra-red treatments, diathermy, massage, or gymnastic work with very little direction from a physician, and can do no particular harm if her technic is poor, but it is as absurd for a technician to give ultra-violet without the direction of a physician

as it is to give tuberculin or digitalis under the same condition. You might order a nurse to give a certain dose of tuberculin, but you would not tell a nurse simply to give tuberculin treatments. The Council on Physical Therapy of the American Medical Association and the American College of Radiology both agreed to divide radiology and physiotherapy at the ultra-violet, and that the ultra-violet belongs in the department of radiology, so that when we speak of a department of physiotherapy we should not include the ultra-violet, because there is at present much confusion regarding its proper use in many hospitals, especially the smaller ones. In these, the ultra-violet generators are frequently put in charge of a nurse in the physiotherapy department and little or no attention is paid to them by physicians. We, as radiologists, must follow the recommendations of the College of Radiology and the American Medical Association and change this situation.

There is one use of the ultra-violet that I did not hear mentioned, the so-called immunity reaction. It has been shown that if an erythema, no matter how slight or how large, so long as it is an erythema, is produced on the body over more than a certain fraction of its surface, a lowered immunity results. If it is less than this maximum fraction, there is an increased immunity. For practical purposes an erythema of not more than the front or back of the trunk or the same of the legs results in an increased immunity. If an erythema is produced over the entire body, the resistance to infection is temporarily lowered. It is also true that one can do the same thing by almost any irritation that will result in an erythema; hence the value of the mustard plaster.

I wish to disagree with the statement that ultra-violet should be used before the roentgen ray when treating acne. If an acne does not clear up after from four to six treatments with the roentgen ray, a few mild peelings with the ultra-violet usually complete the cure. And I have found that reversing the procedure does not give as good results.

I think Dr. Coulter's paper was a little optimistic on the treatment of dermatophytosis. In California we have many such cases, and we find it necessary to treat one with Whitfield ointment and another with the X-ray, and still another with mercurochrome or carbolfuchsin compound, etc. A few benefit markedly from the use of ultra-violet, especially in combination with the Whitfield ointment, but unfortunately the procedures that will work perfectly with one patient may be an entire failure with another.

Dr. Rodney Atsatt (Santa Barbara, California): As Dr. Ullmann has said, the General Electric Company loaned us, some time ago, one of their large radio heat machines and we have been using it, among other things, for the treatment of arthritis. We have found that a twenty-minute exposure will raise the temperature about one degree Fahrenheit. If the exposure is prolonged, the temperature increases. The pulse is increased slightly during this exposure; the respirations do not change. We have treated about fifty cases so far, with about 50 per cent of them showing marked improvement, about 25 per cent more showing some improvement, and about 25 per cent of them being unchanged. The ones which show marked improvement are the ones in which the sensation of well-being and general warmth is produced by one exposure. They are the ones who get the most benefit from it. It is too early to make any definite statement as to prolonged benefit or the length of the benefit derived, but some cases have run over a year now and are still improving from the arthritic standpoint. There are metabolic changes

which go on in this heating process which have something to do with the biochemistry of the patient. We take in the trunk, hips, elbows, hands, and wrists at one treatment, and the hips and knees and lower trunk in another sitting. We believe that this machine gives better effects than diathermy as usually applied.

DR. STAFFORD L. WARREN (Rochester, N. Y.): I have been studying diathermy experimentally for about three years now, and it seems to me there are two factors not taken into consideration by all of us. One is the part played by the circulating blood in taking heat out of the area being treated by diathermy, and the other is the duration of the treatment. We have found by making thermocouple measurements in the joints, and especially the knee joint, that it takes from three-quarters of an hour to an hour to heat the joint fluid to forty-one and a half degrees centigrade. In most physiotherapy departments it is customary to give the patients a twenty-minute treatment; if one is going to do any more than just increase the circulation in that area, for instance, if one is trying to kill the bacteria, he has to keep the diathermy on much longer than is customary. We have found that when one turns the diathermy off, the blood takes out the heat at a very rapid rate. One can prevent that by producing stasis, but we have found that that is dangerous, in dogs, at least.

I have heard considerable discussion lately about the influence of frequency in high frequency currents. We have tried direct and indirect methods of calorimetry, and we have found that within the limits of our experimental error, the effects of currents of all frequencies at our disposal are identical. Setting up two frog muscles in separate chambers (Warburg type), balancing one against the other, and using various frequencies on one muscle and the other as a control, Dr. Wallace Fenn was unable to get more heat by any of the high frequencies than he was able to get by an equal amount of sixty cycles alternating current.

THE MIGRATION OF EPINEPHRIN IN A NEW APPARATUS FOR ELECTRODIALYSIS

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CONSIDERING the importance of electrodialysis in biological investigations, one of us (Sokoloff)[1] suggested to Dr. N. Michailovsky the construction of an improved apparatus which could be used for the study of the migration of epinephrin. Before stating the results of the latter experiments, we shall describe the new apparatus for electrodialysis.

Figures 1 and 2 show the apparatus which has been used in our work with epinephrin. The improvement concerns the construction of the glass cell in which the electrolysis is carried out. The cell is built in three parts: A., M., and C., which correspond to the anode, middle, and cathode divisions. Divisions C. and A. are attached to the middle division by two clamps in such a way as to allow them to be separated if desired. Between the three divisions it is possible to place two diaphragms with a diameter of 3½ inches. Each diaphragm is held in position tightly between the divisions by means of two rubber rings. Filters of various kinds can be used in combination with these diaphragms. The electrodes are removable, so that it is possible to use different kinds of electrode material. They have an area of 38 sq. cm., and are made of fine wire mesh. The glass cylinders which form the anode and cathode divisions have circular openings about ½ inch in diameter through which it is possible to withdraw or add the solution of epinephrin and also to observe the temperature. It is possible to let water circulate through the Divisions A. and C. by means of suction and in this way to replace the used liquid with new fluid, thus assuring a perfect removal of electrolytes. Figure 1 shows an arrangement in which water circulates through the two side divisions containing the two electrodes. The big flask, D, on the left contains distilled water which is drawn up into Divisions A. and C. by means of a vacuum pump (v) and is collected in the two smaller bottles (B_1 and B_2). The vacuum is indicated by a manometer, E, which is attached on top of the control board. The cell in which the electrodialysis is carried out is attached in such a manner that it can be rotated by means of the agitator, F, which is operated by a compressed air motor.

The apparatus can be operated by a direct or alternating current, using a wide range of current intensity and potential. It is possible to take readings from one milliampere to ten amperes and from one to one hundred and fifty volts. Indicators are provided to take readings by alternating and direct current. A sensitive rheostat, R, is connected in the circuit of the ammeters. The conditions of the middle division are such that primarily only dissociation and migration can occur. We used as diaphragms Norton Alundum Filter Discs 3½ inches in diameter and 5/32 inch in thickness, having a porosity of 43.9 per cent. At 20° C. the electrical resistance of this filter disc is 9×10^6 ohms, cm. cube.

With the apparatus described above, we carried out at first a series of migration experiments with epinephrin. Next we followed the behavior of the epinephrin during the process of electrodialysis. For this purpose we added epinephrin to the middle division of the cell in order to study a possible migration of the substance through different membranes, like the Norton Alundum membrane mentioned above. In addition, we used ultra-filtration membranes and cella

[1] Compt. rend., 1929, CL, 888.

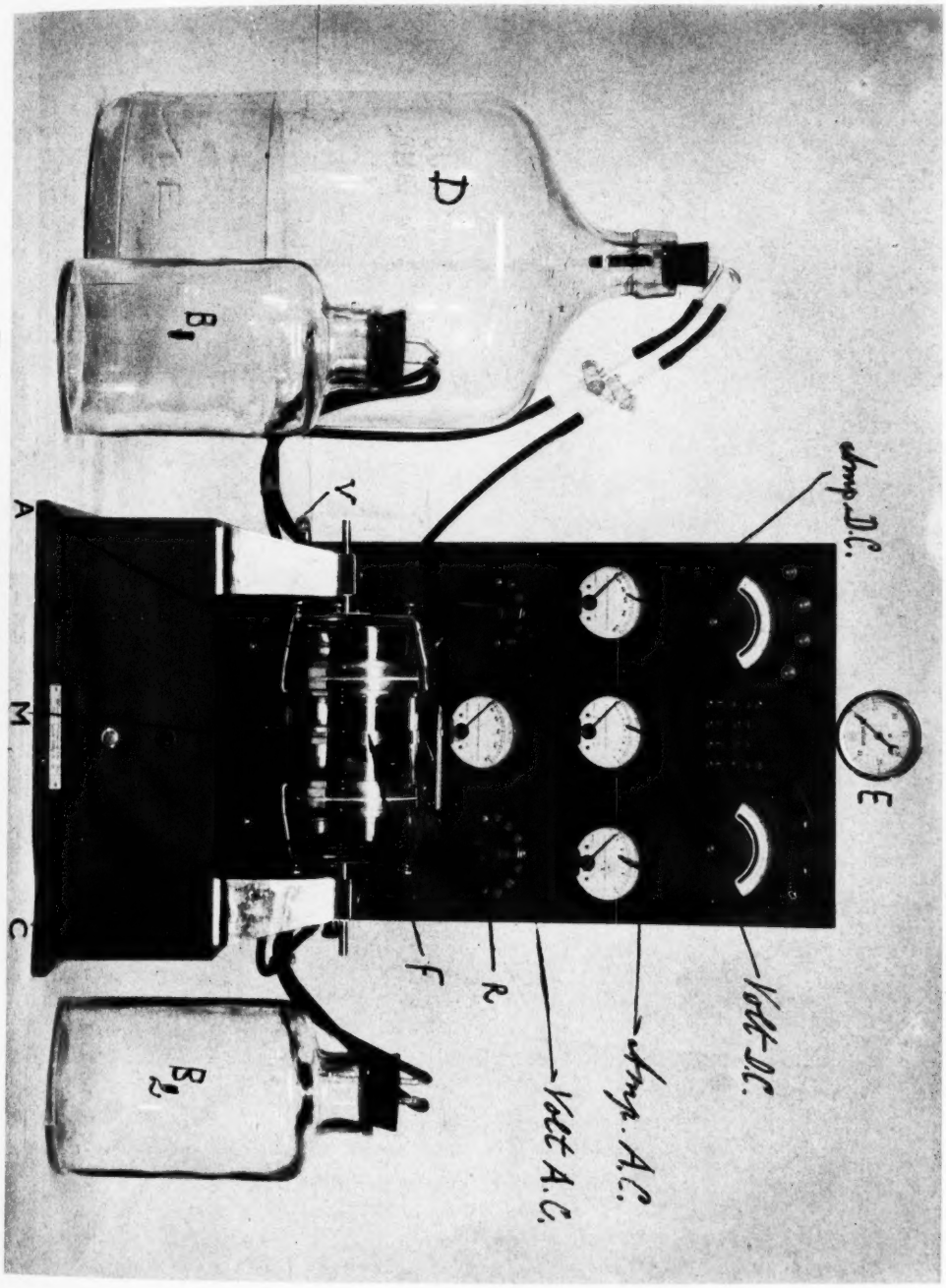

Fig. 1. Apparatus used in the authors' work with epinephrin. See text.

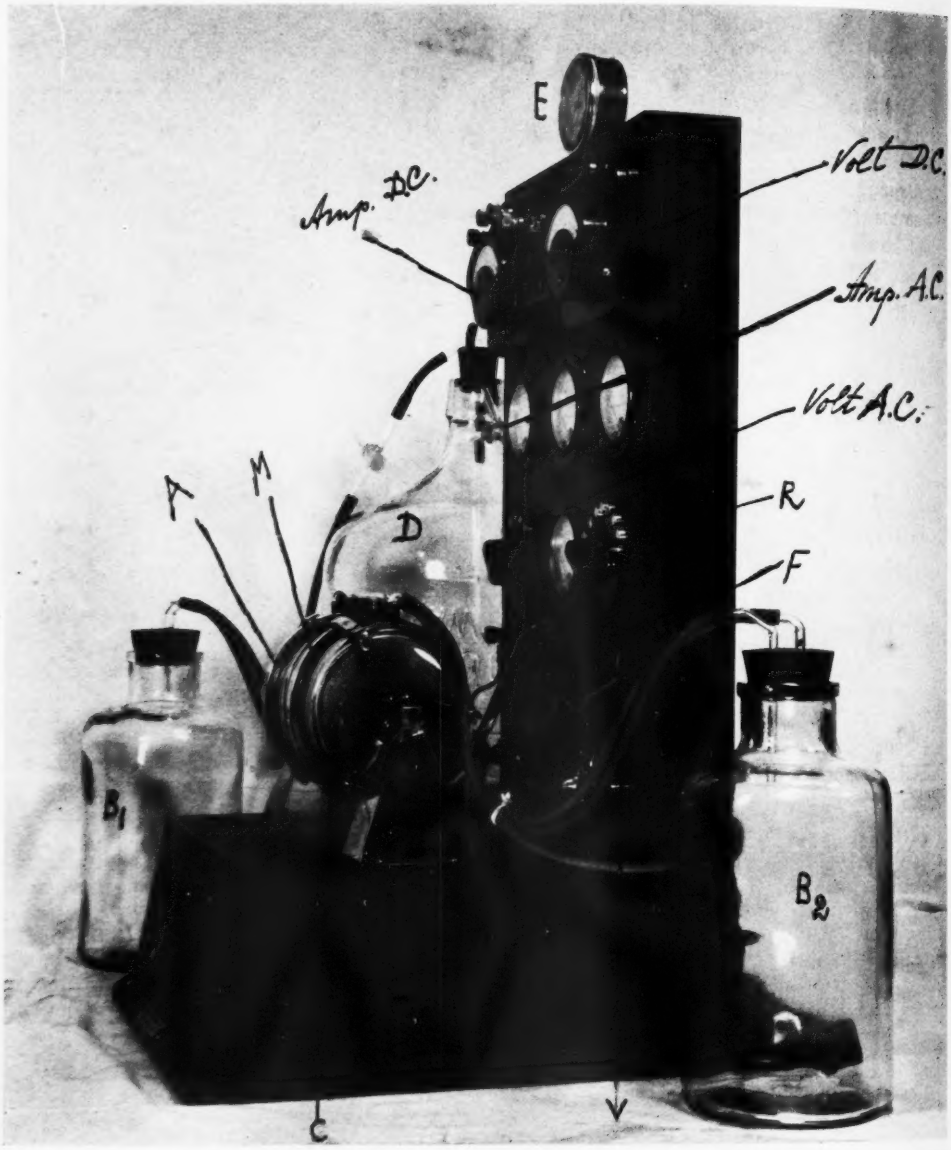

Fig. 2. Another view of the authors' apparatus. See text.

filters of Zsigmondy in combination with the Alundum diaphragms.

Our investigations were carried out in the following manner: The migration of epinephrin from the middle division to the side divisions was observed in acid, and neutral, in alcoholic as well as in salt solutions. The possibility of reverse migration from the two electrode divisions to the middle division was also considered.

It was proved that under the influence of direct current a migration of epinephrin oc-

curs in the directions toward both electrode divisions. The first experiments were carried out under continuous circulation of water in the electrode divisions. Epinephrin in aqueous and alcoholic solutions which had

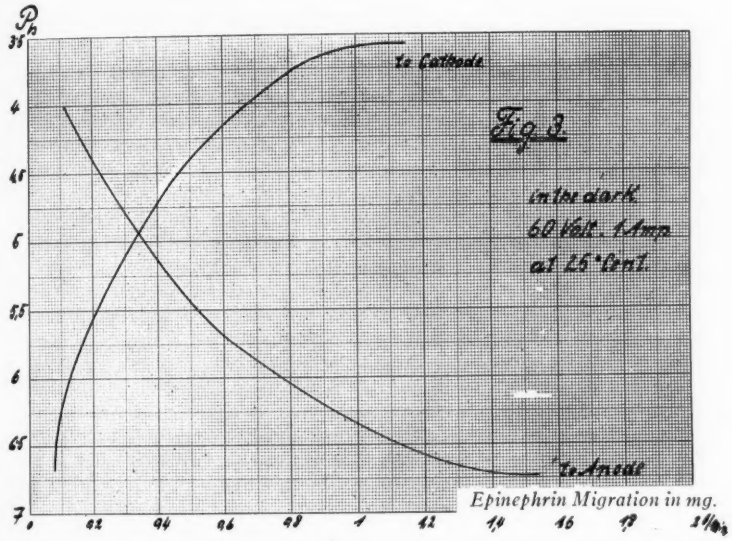

Fig. 3. Curve showing the influence of pH on the migration of epinephrin. See text.

been added to the middle division was removed from this part of the apparatus by migration toward the electrodes. Using a current of 40 milliamperes and 60 volts, 10 milligrams of epinephrin hydrochloride in an aqueous solution of pH 4.2 could be removed by means of dialysis in eight hours, and it was found in the circulating wash water. Quantitative investigations showed that about 30 per cent of epinephrin removed was decomposed by electrolysis under the action of air and light. Epinephrin was not retained by the Alundum discs nor by the various Zsigmondy filters. The same results could be obtained by using epinephrin in alcoholic solution. Quantitative experiments showed that the migration of epinephrin in the direction of both poles occurs unequally. A more pronounced migration could be found to take place in the direction of the anode than in the direction of the cathode. In this way it was found that after the addition of alkali or alkaline salts to a solution of epinephrin hydrochloride a greater migration occurs to the positive pole and that the addition of acid or acid salts effected a greater migration in the opposite direction. The following table presents experimental results obtained by adding different electrolytes.

A current of 60 volts and 4 milliamperes at 25° C. was applied to 20 milligrams of epinephrin solution of pH 4.2.

After five hours the amount of epinephrin which was present in each of the three divisions was determined. The quantitative experiments were carried out by the Folin method as modified by Hitchcock and Benedict, using the colorimeter of Duboscq. An

TABLE I

	Added	.01 N	HCl	Added	.01 N	NaCl	Added	.01 N	KOH
	A.	M.	C.	A.	M.	C.	A.	M.	C.
Exp. 1	1.7	13.4	1.9	.7	15.6	.8	3.7	12.4	1.3
Exp. 2	1.4	13.8	2.0	.5	15.2	.8	3.1	11.9	1.9
Exp. 3	1.6	13.7	1.7	.9	14.9	.7	3.8	11.1	1.8

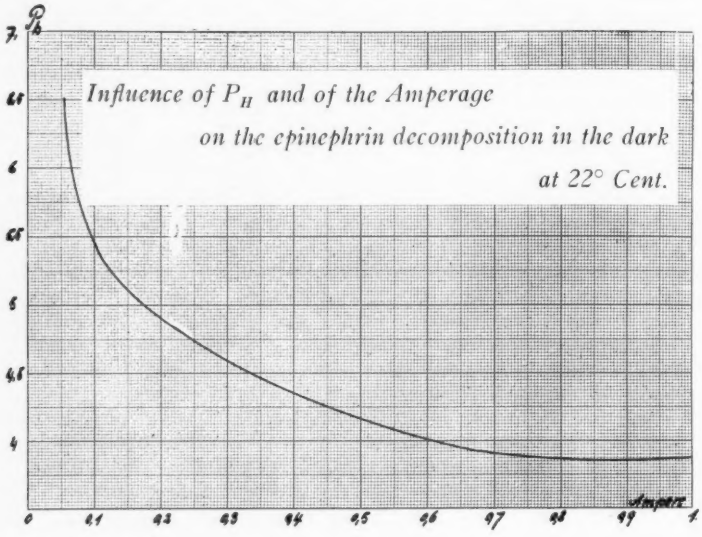

Fig. 4. Curve indicating the influence of the pH and the amperage upon the decomposition of epinephrin.

average of about 15 per cent of epinephrin was decomposed by these experiments in all three divisions. Considering the results indicated in the table we can see that in a solution of HCl more epinephrin was found to be present in the cathode division than in the anode, and, therefore, we can draw the conclusion that under these conditions a migration to the cathode is predominant. Using a NaCl solution a migration from the two electrode divisions to the middle division seems to occur. This phenomenon can be explained by assuming that by electrolysis at the anode acid will be formed and at the cathode alkali will be formed, and that these secondary products effect a change in the electric charge of the epinephrin. As a result of this reversion in the electrical charge of epinephrin, this substance will now be carried away from the pole in the direction of the middle division. We found that at a certain hydrogen concentration the migration in the direction of the cathode and of the anode will be about equal. Figure 3 shows the influence of pH on the migration of epinephrin. The point where the curve representing the anodic migration intersects with the curve representing the cathodic migration has a pH of 5.1, using a current of 60 volts and 0.100 milliamperes at a temperature of 25° centigrade. The equilibrium point is naturally dependent upon the strength and potential difference of the currents which are used. The hyperbolic curve in Figure 4 indicates the influence of the pH and the amperage upon the decomposition of epinephrin. It will be noted that lowering the current intensity causes a fall in

the equilibrium to pH 7, however, without ever reaching this point. This character of the migration of epinephrin under the influence of an electric current suggests the possibility that movements of epinephrin in the adrenal gland, as well as in other directions in the living animal, may also be influenced by electrochemical factors.

Presumably this influence could be effected by various kinds of potentials. We may, furthermore, conclude that epinephrin behaves electrochemically like an amphoteric substance in which, in neutral solution, the basic character is somewhat predominant.

The new apparatus can be used for various biological studies. As was reported (Proc. Soc. Exper. Biol. and Med., 1930, XXVIII, 79, 80), in order to study the behavior of the living tissue in the described apparatus, we have undertaken the investigations on *Paramaecium caudatum,* chicken-sarcoma Rous, and other cancerous tissues, as Flexner carcinoma and sarcoma No. 10 and No. 39.

This apparatus can also be used for studies of the influence of X-rays upon dialysis.

CONCLUSIONS

1. The apparatus constructed by Dr. N. Michailovsky for electrodialysis has been tested and found useful for biochemical purposes.

2. The migration of epinephrin passing in this apparatus through Alundum membranes and various ultra-filters of Zsigmondy was analyzed.

3. The migration of epinephrin to both electrodes varies with the pH of the solution and the strength of the current.

4. The amount of epinephrin migrating to the electrodes using varying strengths of current and different pH was determined.

5. The pH of the solution has, as we found, a pronounced influence on the direction of the migration of epinephrin.

6. At a certain pH of the solution epinephrin behaves in an electric current like an amphoteric substance, in which the alkaline character is predominant.

CASE REPORTS AND NEW DEVICES

FINAL REPORT ON A CASE OF BONE CYST OF THE PATELLA

By WALLACE H. COLE, M.D.,
ST. PAUL, MINNESOTA

In 1925 the author reported a case of what was apparently a cyst of the patella, which had remained cured for nearly two years following resection of part of the patella.[1] As this case is somewhat unique and has been followed at intervals up to the present a further report seems justified at this time, not only to show the result of the treatment of the tumor but also to show the effect on the knee joint of removal of part of the patella.

The patient, a woman 31 years of age, was first seen on November 5, 1921, at which time she complained of pain in the left knee on going up or down stairs, inability to kneel upon that knee on account of pain, and limitation of extension of the joint. These symptoms had developed during the previous three months, following a comparatively slight fall upon the knee thirteen months before. At no time had there been any discomfort while the joint was at rest. The history was otherwise negative, except for an old syphilitic infection which had received such very active treatment that six negative Wassermann tests had been obtained during the last year.

Examination was negative objectively except for a limitation of active extension of the knee to about 160°. Passively, full ex-

[1] Primary Tumors of the Patella. Jour. Bone and Joint Surg., July, 1925, VII, 637.

Fig. 1. Roentgenogram of knee showing a rarefied cystic condition in lower part of patella. Taken on November 3, 1921.

Fig. 2. Roentgenogram of patella taken on December 2, 1921, showing increase in rarefied area, with definite projection of tumor tissue into knee joint.

Fig. 3. Photomicrograph of lining membrane of cyst, showing giant cells and a highly cellular osteitis fibrosa.

Fig. 4. Roentgenogram of patella taken on March 6, 1922, two months after curettement of cyst. Shows cavity apparently filling in with new bone. The projection into the joint is still present.

tension was possible, but a painful catch was present at one point during this procedure. Palpation revealed slight tenderness over the lower part of the patella.

A roentgenogram brought in by the patient and taken on November 3, 1921, showed a rarefied, cyst-like condition in the lower part of the patella, with apparently an intact bony shell, although in the light of later roentgenograms there was probably some roughening of the articular side of the lower third of the bone (Fig. 1). Treatment was delayed for further study. A second roentgenogram was taken on December 2, 1921, and this showed that the condition was progressing and that the posterior wall of the patella had broken down, with the projection of what was presumably tumor tissue into the knee joint cavity (Fig. 2). A diagnosis of solid or cystic tumor was made, although the possibility of tuberculosis or syphilis was discussed.

On January 10, 1922, the patella was operated upon and a piece of the anterior wall removed, disclosing a cavity containing clear fluid and lined with what appeared to be granulation tissue. The posterior wall of the cavity had perforated into the knee joint. A thick lining membrane was stripped from the anterior wall of the cavity, but no definite lining other than the thin granulation tissue-like material was found otherwise. On curetting, this tissue bled very freely and, to control this, a pack was inserted. Two days later the pack was removed and the wound went on to perfect healing.

Pathologically, the gross specimens resembled small blood clots except for the lining membrane, which could be stripped from the fragment of bone removed from the anterior surface of the patella. This latter tissue alone could be sectioned and mi-

Fig. 5. Roentgenogram of patella taken on August 21, 1922, showing definite recurrence of cystic tumor.

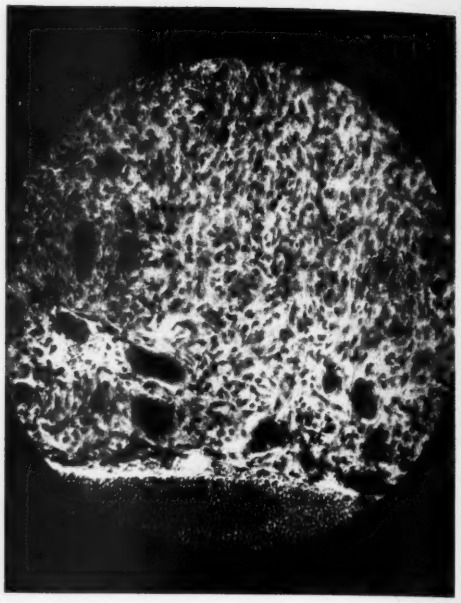

Fig. 6. Photomicrograph of tissue removed at second operation. Note similarity to structure shown in Figure 3.

croscopically showed what was, apparently, a highly cellular osteitis fibrosa, with mitotic figures common and some giant cells. Dr. Bloodgood examined the slides and reported the diagnosis and classification as "bone tumors — osteitis fibrosa — cyst — patella" (Fig. 3).

The patient's convalescence was uneventful and, except for a slight limitation in the extreme of flexion, the full range of motion returned to the knee joint. A roentgenogram taken on March 6, 1922, showed a cavity filling in with new bone, but with still a definite mass projecting into the joint cavity (Fig. 4). Some tenderness returned over the lower part of the patella by August, 1922, and a roentgenogram taken on August 22 showed a definite recurrence of the cystic condition (Fig. 5).

The patient did not allow a second operation until March 13, 1923, but on that date a resection of the lower half of the patella was performed and the raw surface of the remaining portion cauterized with pure phenol. The wound healed uneventfully and in two weeks the patient was walking around with crutches. The pathology of the tissue removed at this operation was practically the same as that found primarily. There were many giant cells but not enough to classify the growth as a giant-cell tumor (Fig. 6).

The roentgenogram taken on May 18, 1923, shows the extent of the resection (Fig. 7). At this time the function of the knee was absolutely normal. Since that time the patient has been seen at intervals and at

Fig. 7. Roentgenogram of patella taken on May 18, 1923, two months after resection of the distal half of that bone.

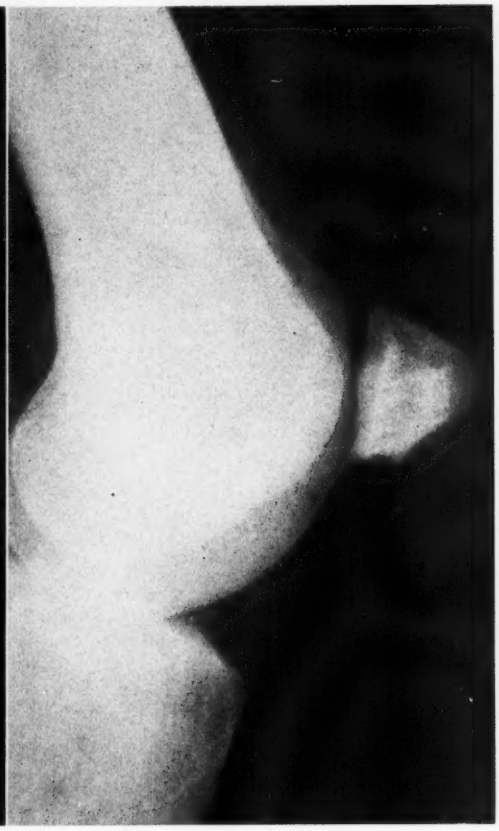

Fig. 8. Roentgenogram of patella taken on July 8, 1924, showing condition sixteen months after partial resection.

no time has the knee given any trouble. The woman is of heavy build but very active, and bowling is one of her frequent recreations.

A film taken on July 8, 1924, showed absolutely no signs of recurrence and a definite "rounding off" of the resected surface of the patella (Fig. 8). No apparent change has occurred since that time, and a roentgenogram taken on October 28, 1930, can hardly be distinguished from the one taken in July, 1924 (Fig. 9).

We have here, therefore, a case which seems to fit definitely into the class of osteitis fibrosa with cyst formation, the lesion being in the patella, a situation which has never been mentioned in the literature by anyone so far as can be found.

Cure can definitely be claimed, as the knee has been functionally normal over a period of more than seven years following resection, and roentgenograms have shown no changes taking place in the patella during the last six years. There has been no apparent tendency toward arthritis in the knee joint, even with the lower half of the patella gone, and the remaining portion seems to function as perfectly as does the entire bone in the other knee.

Fig. 9. Roentgenogram of patella taken on October 28, 1930. It is difficult to see any difference between this film and the one taken six years previously. (Cf. Fig. 8.)

A CASE OF RECURRENT GIANT-CELL TUMOR OF THE LOWER RIGHT RADIUS

By J. SHELTON HORSLEY, M.D.
RICHMOND, VIRGINIA

The patient whose case is reported, Miss L. Y., aged 37 years, stenographer, first consulted me on April 13, 1928. Her family history was negative for malignancy. The patient's general health had been good except for two fairly severe attacks of influenza, and paratyphoid about 1924. She had been extremely nervous and had had three or four "nervous breakdowns." She had gained weight during the past year. Wassermann tests were consistently negative, and other laboratory examinations were negative.

She had noticed a tumor at the lower end of the right radius for at least two years before I first saw her (Figs. 1, 2, and 3). The growth had been treated with X-rays and finally was operated upon elsewhere about the first of April, 1927, the growth being thoroughly curetted. Roentgenologic examination on October 21, 1927, seemed to show a recurrence (Fig. 4).

When I saw her there was a tumor of the lower end of the right radius, appearing chiefly on the palmar surface (Figs. 5 and 6). The skin over it was stretched rather tightly and seemed to be quite vascular, though it was not definitely adherent to the growth. No axillary lymph nodes were palpable.

On April 25, 1928, I operated, under local anesthesia, resecting the lower end of the right radius, with the immediately surrounding soft tissue, doing all of the dissection with the endotherm knife except that the bone was divided with bone forceps. The block dissection included the adjacent tendons around the lower end of the radius. After removing this mass there appeared to be a small amount of tumor tissue between the tendons. This was dissected away with the endotherm knife. The head of the metacarpal bone of the thumb was removed with forceps. The bone after division was immediately cauterized with the coagulation current.

Histologic examination showed a typical giant-cell bone tumor. There were many giant cells and a stroma of spindle cells and connective tissue. The tumor was rather cellular. There were no mitotic figures (Fig. 7).

The patient made a satisfactory recovery, the wound healing without infection. Roentgenologic examination May 15, 1929, showed no evidence of recurrence (Fig. 8).

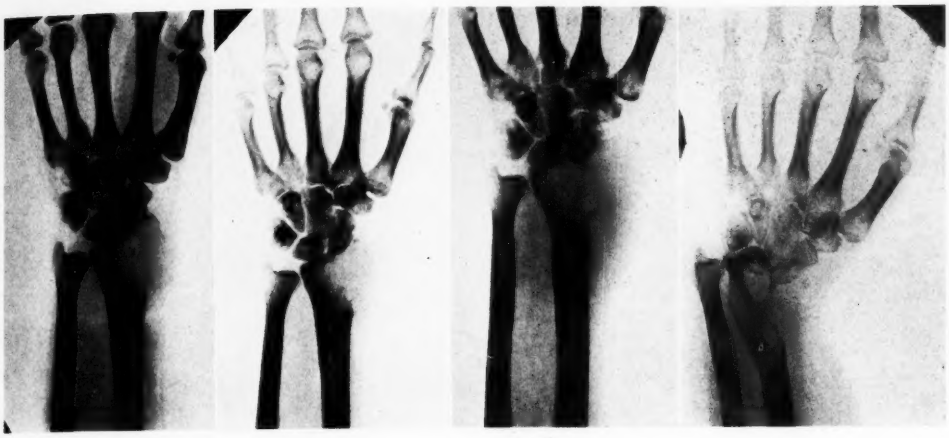

Fig. 1. Fig. 2. Fig. 3. Fig. 4.

Fig. 1. Roentgenogram of right wrist (January 29, 1927).
Fig. 2. Roentgenogram of same wrist (February 3, 1927).
Fig. 3. Roentgenogram of same wrist (March 28, 1927). This and the two preceding films were made by Dr. V. W. Archer, at the University of Virginia, shortly before X-ray treatment and operation by Dr. Joseph C. Bloodgood.
Fig. 4. Roentgenogram by Dr. V. W. Archer of same wrist (October 21, 1927), about seven months after the operation by Dr. Bloodgood, showing apparent recurrence of the tumor.

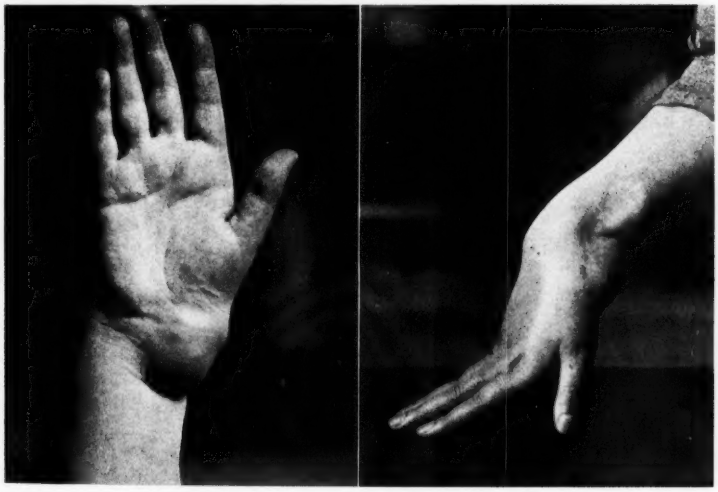

Fig. 5. Fig. 6.

Fig. 5. Photograph (April 24, 1928), of the palmar surface of the right wrist, showing the recurrent growth which also involved the soft tissues around the lower end of the radius.
Fig. 6. Radial view of the recurrent growth (April 24, 1928).

On May 16, 1929, I operated upon her again for reconstruction of the right wrist, the operation being done under ethylene anesthesia. The stump of the radius was exposed, and the tip of it cut off with bone forceps. The lower ulna was exposed for

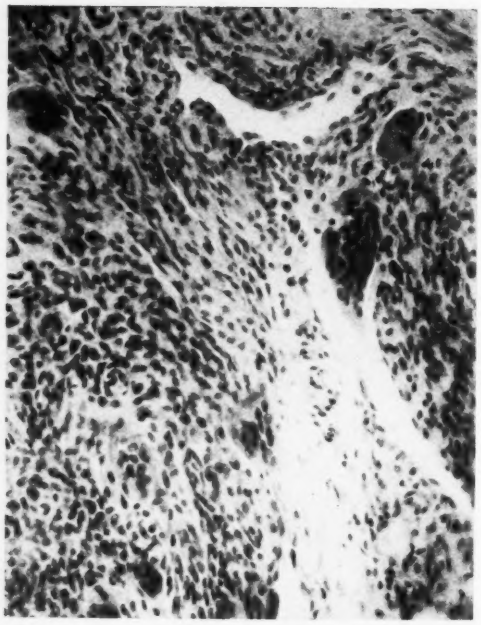

Fig. 7. Photomicrograph of tumor tissue, removed (April 25, 1928). There are numerous giant cells of foreign body type, and rather vascular stroma. The blood vessels appear about normal (× 250).

Fig. 8. Roentgenogram by Dr. Fred M. Hodges of same wrist (May 15, 1929), nearly thirteen months after the removal of the recurrent giant-cell tumor. There is no evidence of recurrence, but a marked deformity due to the defect in the radius.

about four inches, and divided with bone forceps about one and one-half inches from its end. With the electric drill the distal end was hollowed out, and the proximal end of the radius was drilled. A bone peg was cut with the electric saw from the ulna and made to fit into the distal fragment of the ulna and the proximal end of the radius as a medullary graft. The end of the graft in the radius and the ulna were held in position to the bones of the wrist joint with sutures, and a strip of preserved fascia was wrapped around these bones in such a manner as to interfere with the tendons as little as possible (Fig. 9).

The patient was last heard from July 25, 1930, and there seemed to be no evidence of recurrence. However, it is interesting to note the gradual absorption of the graft and of the lower end of the ulna (Figs. 10 and 11). The bone peg seems to have disappeared and the transplant of the end of the ulna onto the end of the radius has been largely absorbed. The distal portion of the ulna from which the bone peg was taken has also been absorbed to a marked extent. There appears to be no return of the growth, but the cause of the absorption of the graft is difficult to determine. Whether it may be due to some constitutional condition, to intensive treatment with X-ray, or to the dissection with the endotherm knife, it is impossible to say. It seems, however, under the existing conditions that any

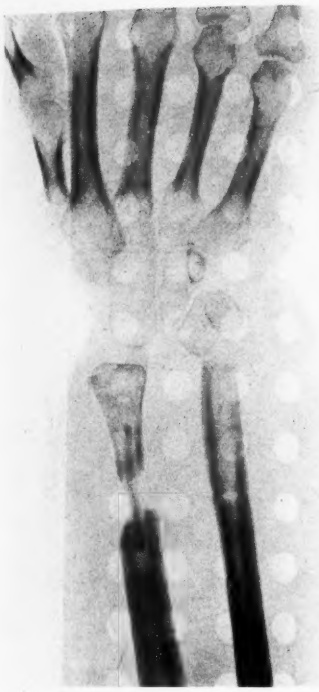

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Fig. 9. Roentgenogram by Dr. Fred M. Hodges of same wrist (June 7, 1929), twenty-two days after reconstructive operation in which a portion of the ulna was transplanted with a bone peg taken from the shaft of the ulna, to the end of the radius. X-ray shows the wrist in good position and the alignment of the ends of the bones satisfactory.

further bone-grafting would be inadvisable, and that a brace or splint will be the most satisfactory means of maintaining such function as she has.

ADENOCARCINOMA OF THE BREAST: CASE REPORT

SIX-YEAR INTERVAL FOLLOWING AMPUTATION OF THE BREAST—FINAL GENERAL OSSEOUS METASTASIS

By G. S. FOSTER, M.D., Surgeon to the Lucy Hastings Hospital
MANCHESTER, NEW HAMPSHIRE

The patient, Mrs. L. P., female, white, aged 49 years, married for 20 years, by oc-

Fig. 10 *(left)*. Roentgenograms by Dr. V. W. Archer of same wrist (November 22, 1929). The bone peg has apparently been absorbed and the wrist has been displaced forward. The lateral view shows marked atrophy of the end of the ulna.

Fig. 11 *(right)*. Roentgenograms of same wrist (July 25, 1930), showing an accentuation of the condition shown in Figure 10. The bone transplant at the radius is still further absorbed, and the end of the ulna has also undergone further absorption. There is no evidence of recurrence of the tumor.

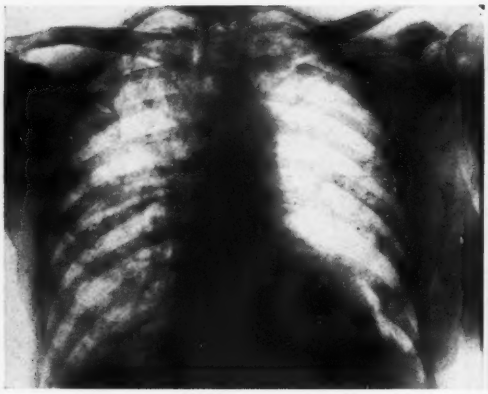


Fig. 1. Roentgenogram of lung field.

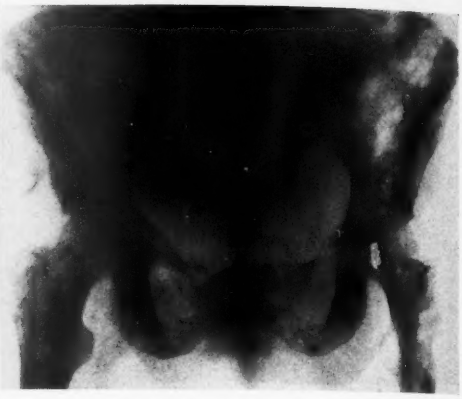


Fig. 2. Metastases to the bones of the pelvis.

cupation a housewife, was admitted to the hospital on May 3, 1923.

Family History.—Father died at the age of 71 years of "cancer of the throat"; mother died at the age of 70 years of "apoplexy"; no brothers; one sister living, well and strong.

Chief Complaint.—The first sign noticed by the patient of any abnormality, about one week before admission, was that the nipple of the right breast was a trifle sunken, whereupon she observed her breasts closely and discovered a "swelling" in the right breast—it felt hard and was about the size of a hen's egg. This was not tender "to handle and there was no discharge from the nipple," the patient stated. Feeling concerned regarding this discovery she im-

Fig. 3. Metastasis to the humerus.

Fig. 4. Metastasis to the radius.

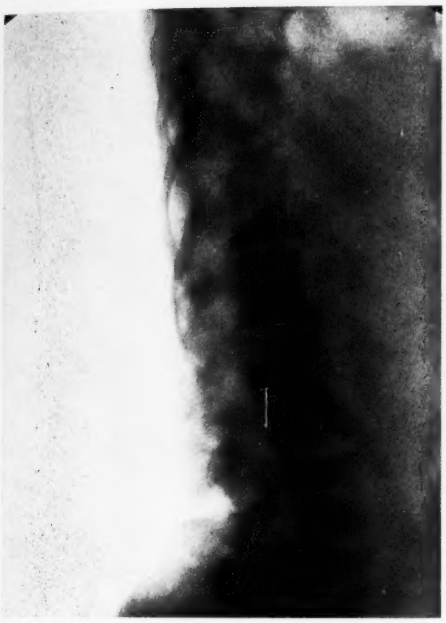


Fig. 5. Lateral roentgenogram of the spine, showing metastasis.

Fig. 6. Roentgenogram showing involvement of the tibia.

mediately went to her family physician, Dr. Samuel Cogswell, who recognized the importance of the situation and referred her to the hospital. During the following two years she lost no weight and felt well and strong.

There is no family history of tuberculosis, insanity, epilepsy, diabetes, or Bright's disease. Her father died of "cancer of the throat" at the age of 71 years, as stated above. The patient is prone to constipation; has a good appetite; sleeps well; micturition is normal; never has had any burning or smarting. In childhood she had chicken pox, measles, and mumps, with good recoveries; at 10 years of age, scarlet fever, with good recovery; at 20, diphtheria, with good recovery, no complications; at 26, typhoid fever (severe), but made good recovery finally, no complications. Other than the above-mentioned sicknesses she has always considered herself as vigorous and strong, compared to other women. There was no history of injuries or surgical operations. Her habits were normal, including the drinking of tea and coffee.

Menstruation had been established at the age of 16 years; always regular; flows five days; very little pain precedes the establishment of flow; color is generally bright red with no clots. Venereal disease is denied. No leukorrhea.

Parturition.—Two boys, one girl; oldest 25 years of age, youngest 12 years of age; normal deliveries; no miscarriages; all children living and well.

Climacteric.—During the past year she has three times skipped a menstrual period. Patient thinks she is undergoing the menopause.

Working Diagnosis.—After physical examination, a malignancy of the right breast.

Fig. 7. Metastasis to the skull.

General Condition. — Temperature, 98.6°; height, 5 ft., 8 in.; weight (normal), 142 pounds; pulse rate, 80, pulse character, good; blood pressure, 130(s.), 80(d.); respiration, 16, character of respiration, even and full; nutrition, well developed and nourished, general appearance of one in very good health, no evidence of recent, sudden loss in weight; teeth, all extracted; tongue, furred and moist; head, normal in size and shape; scalp, good growth of hair, no eruptions, brunette type; face, good countenance, no eruptions; neck, normal in size, no tumefactions seen, no enlargement of the thyroid gland, no lymphatic nodules; eyes, brown, no discolorations, pupils equal, react to light and accommodation; ears, hearing normal, no deformity; nose, no obstructions in either naris; throat, mucosa slightly roughened, tonsils normal, no leukoplasia present; skin, clean and clear, no discolorations, ulcerations, indentations, depressions, elevations, contractions, pigment areas, or scars noted; no spinal curvature, paralyses, or deformities noted; sinuses, clear; thorax, normal in shape and outline, respiratory excursion even; heart, no abnormal sounds, areas of dullness outlined as normal; lungs, clear and resonant, no dullness or râles detected.

Vascular System.—No enlarged or tortuous veins seen, no enlarged superficial veins; arteries, seem normal in size, without thickening.

Muscular System.—Seems well developed; no discolorations; good co-ordination.

Osseous System.—No bowing or exostosis; no nodular areas found along shafts of various bones; no discolorations or deformities seen.

Nervous System.—Reflexes seem normal; surface senses as pain, touch, pressure, and reaction to thermic changes normal.

Breast (Right).—This breast appears normal in size, slightly pendulated; muscles of this region are rather soft and flabby. No discharge could be expelled from the nipple. The areola was deeply pigmented. The nipple was drawn slightly inward and downward at its outer margin. The skin could not be moved over an area about the size of a twenty-five-cent piece. A nodular mass about the size of a hen's egg was present in the outer lower quadrant of the breast. It was freely movable over the underlying fascia, was rather irregular in outline, and not tender or sensitive.

Abdomen. — Flat, thin, fairly well muscled wall; no points of tenderness or muscular rigidity; Meltzer +; no masses felt; no suggestion of induration; no glands, edema, or ascites.

Hepatic lower border not felt; hepatic area of dullness not increased; spleen not enlarged; neither kidney lower pole felt; stomach and transverse colon not dilated as outlined by percussion; no evidence of hernia, hemorrhoids, fistula, or varicose veins.

Vaginal Examination (per speculum).—The cervix appears normal in size, with one

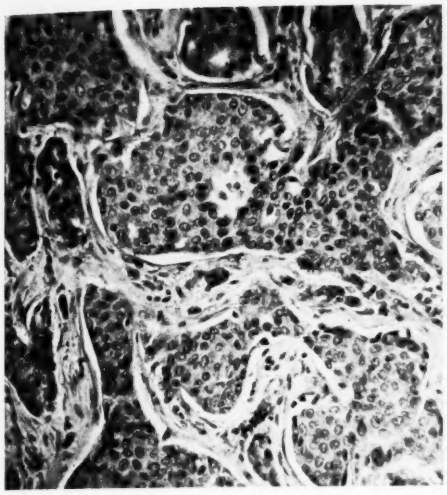


Fig. 8. Photomicrograph of metastatic nodule from breast carcinoma, removed from bone.

LABORATORY FINDINGS

Urine

Date	May 3, 1923
How obtained	Catheterization
Amount, single	10 ounces
24 hours	42 ounces
Color	Amber
Appearance	Turbid
Reaction	Acid
Specific gravity	1028
Albumen	Very slight trace
Sugar	None
Casts	None
Renal test	1° 45 per cent
Renal test (May 4, 1923)	2° 70 per cent

Blood

Date	May 3, 1923
Hemoglobin	75 per cent
Coagulation time	3 minutes
Erythrocytes	4,260,000
Leukocytes	14,800
Polychromatophilia	56
Small lymphocytes	29
Large lymphocytes	10
Eosinophils	4
Myeloblasts	1
Serum reaction	Wassermann negative
Cultures, parasites, etc.	Vagina shows normal flora

small left lateral tear, triangular in form. There is no discharge from the external os, which appears normal. The vaginal mucosa is moderately redundant, with a slight degree of cystocele and rectocele. A culture was made and a smear taken, both showing a normal vaginal flora. Bimanual examination shows the cervix to be freely movable. The fundus uteri is found slightly posterior, normal in size, freely movable, and regular in outline. No tenderness or sensitiveness is elicited in this part. The broad ligaments are not thickened and the tubes and ovaries appear normal, with no tender or sensitive areas. No glands are felt.

Rectal Examination.—Mucosa is smooth, not redundant; no enlarged tortuous veins; no ulcerations or tumefactions are seen.

A consultation was held with Dr. S. J. Cogswell and the subject matter reviewed. The patient and her husband were advised of the gravity of the condition and the future possibilities explained. Operation was done two days later.

OPERATIVE RECORD

Post-operative Diagnosis. — Malignancy of the breast (right): adenocarcinoma.

Pre-operative Diagnosis Complete.— Malignancy of the breast (right).

Temperature, 98.6°; respiration, 16; pulse, 80; blood pressure, 130/80; general condition, good.

Condition during Anesthesia (Ether).— Pulse remained good quality; respirations were even and full; no stimulation was required.

Operation.—Jackson flap, amputation of right breast. A hard, nodular mass the size of a hen's egg was found, with the subcutaneous surface attached to the lower, outer margin of the nipple, producing a moderate degree of retraction of the latter. In the right axilla were found two glands the size of peas. These glands were moderately hard, regular in outline, globular, buried in adipose tissue, and not adherent. The covering of the blood vessels was normal.

Microscopic Findings.—Section of the growth showed considerable connective tissue infiltration scattered between multiple

areas of adenomatous tissue which varied in size and outline. Many of these glandular areas had the basement membrane broken through and the large, irregularly shaped cells protruding through these openings were found to be widely scattered in the surrounding tissue. The pathological diagnosis was adenocarcinoma.

There was no post-operative hemorrhage or shock. The patient made an uneventful recovery and returned to her home at the end of three weeks. At the time of discharge she had full use of her right arm. Subsequent to the operation she was given Coley's fluid and two treatments of X-ray therapy.

For six years following her discharge from the hospital the patient enjoyed the full vigor of health. Over a period of two years she regularly reported to Dr. Cogswell for examination of the operative field. In June, 1929, about six years after the operation, she began to lose weight and strength and found that she could not get about the house and do her work without abnormal fatigue. During the next six months this condition gradually grew worse and she went to her physician for examination at this time.

Dr. Cogswell reports that he found no signs of local recurrence and the pelvic organs were negative. The left breast and axilla were normal. There was a very general muscular flabbiness and the patient moved about slowly, complaining of pain in her spine and hips as well as in the arms. He referred her to Dr. J. S. Bragg for a complete X-ray examination of the osseous system. This X-ray survey revealed a marked involvement of the upper end of the radius, skull, humerus, upper end of the femur, upper end of the tibia, and a few spots in the upper end of the fibula.

The patient gradually lost weight, grew very weak, and in May, 1930, became bedridden. She progressively grew weaker and died in August of the same year. The cause of death was general osseous metastasis involving the bones named.

A USEFUL POSITION FOR EXAMINING THE FOOT

By HOWARD P. DOUB, M.D.,
Department of Roentgenology, Henry Ford Hospital, Detroit, Michigan

For some time we have been using a position for examining the tarsal bones, which has certain advantages over the standard dorso-plantar and lateral positions. Inasmuch as this does not appear to be standardized, we have felt that a brief description of the position as we use it will be worth while.

In this position, the foot is inverted, with the outside elevated to a thirty-degree angle with the film holder (Fig. 1). The central ray is directed perpendicularly to the film and centered over the tarsal bones. We have found that if the angle which the foot makes with the film is increased more than thirty degrees, the external cuneiform tends to be thrown over the other cuneiform

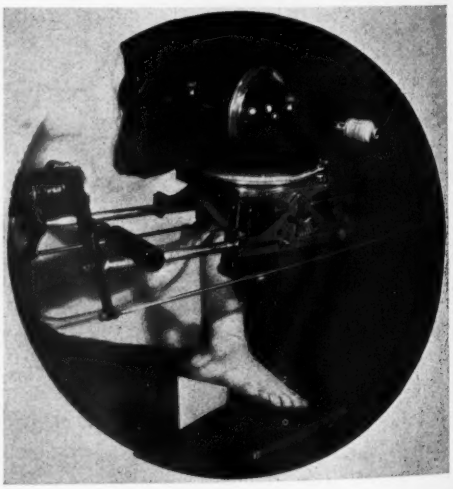


Fig. 1. Roentgenogram showing foot inverted, with the outside elevated to a thirty-degree angle with the film holder.

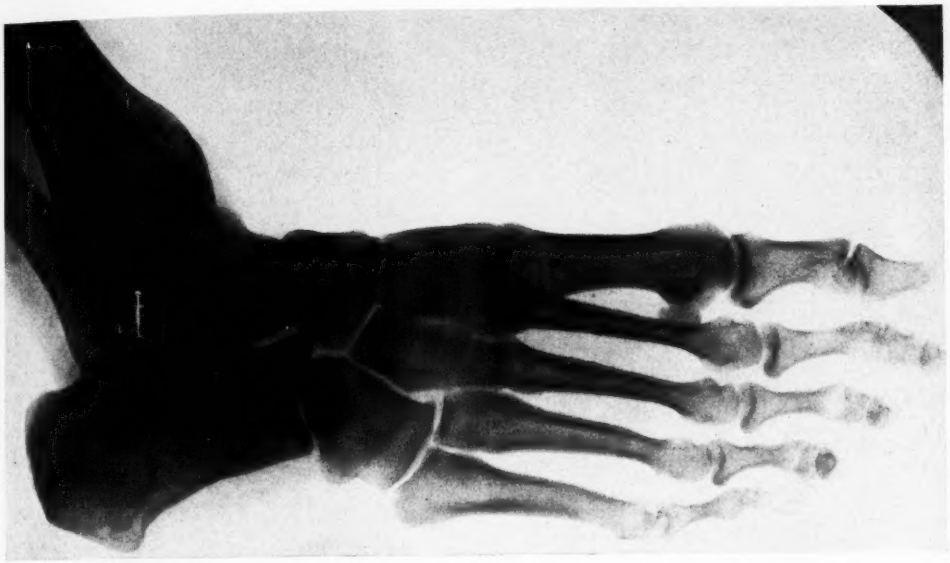


Fig. 2. Roentgenogram showing result from using position shown in Figure 1.

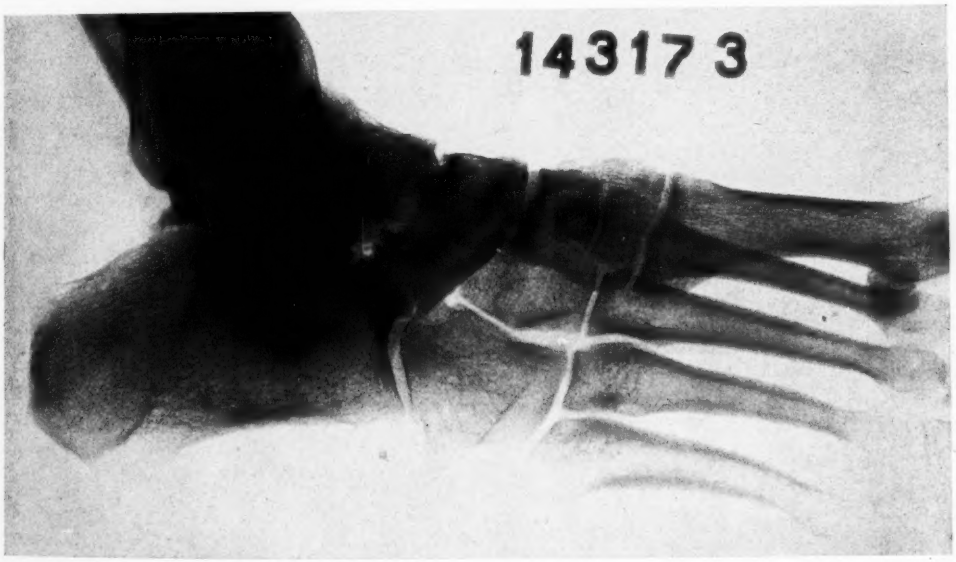


Fig. 3. Roentgenogram demonstrating coalition of the calcaneus and navicular, using this position.

bones so that it is not clearly shown. This angle is easily obtained by making a wooden angle board for insertion under the sole of the foot. The resultant film (Fig. 2) is quite different from that obtained by allowing the foot to remain flat and only tilting the tube.

This position is of particular value in the demonstration of coalition of the calcaneus and navicular, as described by Badgley[1] (Fig. 3). This should be looked for partic-

[1]Badgley, C. E.: Coalition of the Calcaneus and the Navicular. Arch. Surg., July, 1927, XV, 75.

Fig. 4. Roentgenogram showing exact joint surfaces involved in infection of the tarsal and metatarso-tarsal articulations, using this position.

ularly in cases of rigid pes planus, with peroneal spasm.

A lateral view of the external cuneiform without the superimposition of other bones is accomplished quite effectively. The middle cuneiform is less easily demonstrated in the lateral or oblique positions, but can be shown in the dorso-plantar position. The cuboid and navicular are also seen to good advantage. The metatarsal bones and the phalanges are shown obliquely, which is of considerable value in cases of suspected fracture. The talus and calcaneus are not clearly demonstrated by this position.

In cases of infection of the tarsal and metatarso-tarsal articulations, this position has been found to be of great value in determining the exact joint surfaces involved in the process (Fig. 4).

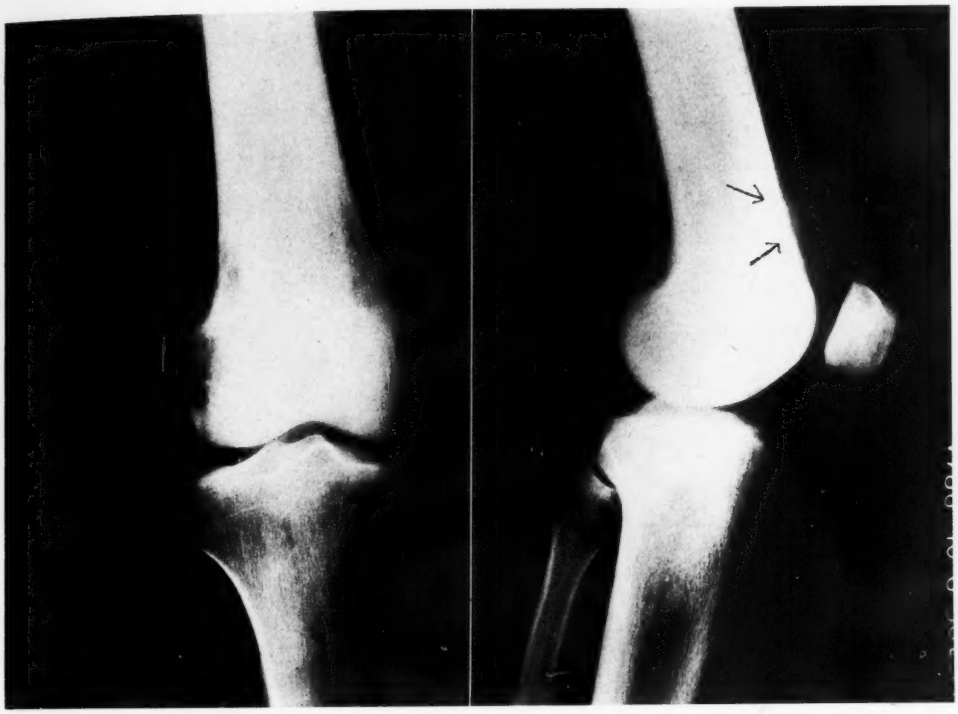
In conclusion, we believe this to be a good position for demonstrating most lesions of the fore-foot, particularly in cases in which we suspect coalition of the calcaneus and the navicular bones or pathology in the external cuneiform.

REPORT OF TWO CASES OF OSTEOGENIC SARCOMA, POSSIBLY TRAUMATIC IN ORIGIN[1]

By BYRON H. JACKSON, M.D.
SCRANTON, PENNSYLVANIA

Case 1. A. F., white, male, German, age 25, by occupation a mine laborer, was admitted to the Moses Taylor Hospital on October 4, 1930. He had been injured August 4, 1930, when he slipped on a piece of sheet iron in the mines, and fell across a railroad rail. He struck both femurs just above the knees, and received contusions over the inside of the right and outside of the left femur, two inches above the knee. He was treated by his physician for contusions for a short time, when the right leg, which was injured on the inside, was completely restored. The patient still complained of slight continual pain in the outside of the left leg, one inch above the knee. Nothing could be felt on examination. X-

[1]Reported before the November meeting of the Philadelphia Roentgen Ray Society, Philadelphia, Pa.



Figs. 1 and 2. Case 1. X-ray examination, made two months from the date of injury, disclosed a periosteal osteogenic sarcoma, and exhibited destruction of the cortex, invasion of the shaft, bony spicules within the soft tumor, and some elevation of the periosteum.

ray examination, made October 4, 1930, two months from the date of injury, disclosed a periosteal osteogenic sarcoma, and exhibited destruction of the cortex, invasion of the shaft, bony spicules within the soft tumor, and some elevation of the periosteum (Figs. 1 and 2). Amputation was refused, and X-radiation is being tried.

This case illustrates a definite trauma at the site of a malignant lesion in a patient who had previously exhibited no evidence of the disease.

Case 2. H. L., aged 13, white, male, came to the Out-patient Department December 8, 1928, complaining of pain in the left knee following an injury three weeks before.

This school boy gave the following history: While playing at school three weeks previously, he had bumped his left leg against a fire hydrant. He had not been to school since, but had not been confined to bed.

The left knee joint is apparently normal. Flexion is complete. The patella is freely movable. There are no signs of fluid in the knee, which is exactly the same in size as its fellow. The upper part of the left leg shows a diffuse fusiform swelling, more marked over the inner surface of the tibia. This swelling extends for about 3½ inches in the long diameter of the leg. The skin is slightly tense, not reddened. The swelling is definitely tender, slightly boggy; no fluctuation is felt, nor egg-shell crackle. The impression is that the bone itself is definitely injured and also that there is considerable swelling and edema in the soft parts. The temperature of the skin over the swelling is apparently higher than on

Figs. 3 and 4. Case 2. We have here a tumor involving the bone and soft tissues of the left tibia, upper, inner border. The tumor of the bone is nearly as wide as it is long. The cortex and shaft are destroyed. There is apparently no attempt at bone repair. There is some evidence of new bone within the soft tumor, with ossifying periostitis below the tumor.

the opposite side. The veins over the tumor are slightly more prominent. The ankle is normal. There is no pretibial edema below the tumor. There are definitely enlarged glands in the left groin and also in the left popliteal space. The glands in the right groin are also palpable, but not nearly so much so. Nothing can be felt in the abdomen.

X-ray Examination.—Films were taken December 8th, of the left tibia and fibula and knee, the right tibia and fibula (for comparison), and the lungs.

X-ray Diagnosis.—We have here a tumor involving the bone and soft tissues of the left tibia, upper, inner border. The tumor of the bone is nearly as wide as it is long. The cortex and shaft are destroyed. There is apparently no attempt at bone repair. There is some evidence of new bone within the soft tumor, with ossifying periostitis below the tumor. A diagnosis of osteogenic sarcoma is made (Figs. 3 and 4). The lungs show no metastasis.

Operation.—At operation, December 17, 1928, under ether anesthesia, the swelling is found to be definitely larger than it was when the patient was examined four days before. The skin is not reddened nor tense, and not adherent to the tumor. There is, however, definite fluctuation. The tumor, especially over the inner surface of the head of the bone where it makes its most prominent salient, is very tender. The inguinal glands have not increased in size since December 13th. An incision about four inches long is made over the inner surface of the head of the tibia. There is some free blood

and edematous tissue present under the skin, which has given the impression of fluctuation. There is no pus. Practically the entire inner surface of the head of the tibia is broken down and can be wiped away with a sponge, without needing any bone-cutting instrument. This exposes a large cavity involving the entire head of the tibia. There is a moderate amount of apparently necrotic cancellous tissue, and clotted blood lying in this cavity, but no definite evidence of new growing bone tissue and no evidence of neoplasm. The walls of the cavity are ragged, irregular, trabeculated, having no smooth lining membrane. The impression, when this tissue is exposed, is that this is a bone cyst which has been broken by trauma and has very extensively degenerated since the trauma. Gross evidence is against pus or neoplasm. The cavity is curetted with the electric cautery and packed with iodoform gauze. Several irregular fragments of necrotic bone have been removed for microscopic examination, some of them to be sent to Dr. Joseph C. Bloodgood. An incision is then made over the most apparent gland in the groin and this removed. It is a flattened gland about ¼ inch thick and 1¼ inch in diameter. The cut surface presents a dull grayish appearance involving about one-half of the central portion. This gland is somewhat suggestive of neoplasm, but is not definite and does not give valuable information until microscopic examination is made.

Microscopic Examination by Dr. J. M. Wainwright.—Gland, inflammatory. Osteogenic sarcoma of tibia.

Microscopic Examination by Dr. J. C. Bloodgood.—Osteogenic sarcoma of the upper end of the tibia shaft.

Diagnosis.—Bone tumor (periosteal sarcoma), osteogenic sarcoma—destructive type, giving an X-ray picture like bone cyst, upper end of the tibia. The following is an extract from a letter from Dr. Bloodgood: "This is a condition I have never seen before, a trauma changing the X-ray picture of a latent bone cyst. I trust you will report this case."

Treatment.—A radium pack was inserted within the cavity, which showed no tendency to granulate. The knee became fixed in a flexed position, with resultant atrophy of the leg and thigh. Later a mid-thigh amputation was done. The patient is now the picture of health. He has an artificial limb, has doubled his weight, and appears to be cured. Since there was no evidence of a bone lesion of any kind before the injury, it seems fair to presume that trauma may have been the causative factor. The contention that a bone cyst might have become malignant does not seem to be borne out by the fact that no lining membrane was found in this bone cavity.

EDITORIAL

M. J. Hubeny, M.D. . . . . *Editor*
Benjamin H. Orndoff, M.D. . *Associate Editor*

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IRRADIATION AND PREGNANCY

The question, "Does maternal pelvic radium or roentgen irradiation injure the health or development of the next generation?" has been asked frequently ever since it was discovered that such treatment could modify ovarian function. If irradiation could produce temporary sterility, the ova to be cast off subsequently might have been permanently damaged. Fertilization of these ova might give rise to the birth of unhealthy or defective children. Furthermore, early experiments indicated that embryonic tissues were peculiarly sensitive to irradiation. This latter fact suggested that serious damage might result from the use of irradiation in the treatment of pelvic diseases in women who might be pregnant at the same time.

The necessity for an investigation in this field became increasingly evident as reports dealing with unhealthy or defective children, whose mothers had received pelvic irradiation, began to appear in the literature. Furthermore, with an increasingly widespread use of radium and roentgen therapy, more women in the childbearing age were being treated with substerilizing exposures. A definite knowledge of the possible relationship between maternal treatment and injury to the child's health could be gained only through a detailed process of research. Accordingly, this study was begun in the manner to be outlined.

As much clinical material as possible was collected. The literature was searched for all case reports bearing upon the subject. Unpublished observations were solicited by means of more than seventeen hundred letters sent to leading gynecologists and radiologists in this country and abroad. These data were then analyzed in order to discover the birth-frequency of unhealthy children. The information contained in these case reports was tabulated. Where important facts were missing, this point was noted. A personal letter was then sent to each observer of an undeveloped or unhealthy child. Information upon the missing points was requested, as well as the latest information regarding the health of the child. In addition to the case reports received from the above sources, some personal observations of the author were included.

The study was concerned with the health of children born after the use of therapeutic amounts of treatment. The influence of diagnostic exposures, either before or after conception, was not investigated. One observer described a child who had been exposed early in its embryonic life to some very short roentgen exposures, used for diagnostic purposes, the mother being under observation for a ureteral or bladder stone. The child was pictured as being a "cross between a Mongolian idiot and a cretin." Since this is the only record dealing with diagnostic amounts of exposure and the birth of a defective child, with the knowledge at hand there is every reason to believe that diagnostic irradiation during pregnancy is harmless.

The reports which dealt with therapeutic degrees of exposure are best viewed in two groups: those which concern children ir-

radiated *in utero* and those which describe children conceived after the maternal treatment had taken place.

A critical study of the records of the children conceived *after* maternal treatment led to the conclusion that such children were unharmed. Clinical evidence and most experimental evidence agree on this point.

Irradiation of the fetus *in utero,* however, gave a different picture. Nearly one-third of a group of 76 full-term fetuses, so exposed, exhibited a serious degree of developmental retardation. Most of these individuals were microcephalic, although other mental and physical defects were observed. The great frequency of underdevelopment and the uniformity of the lesions suggested most strongly that they had a common cause.

The reasons for the fetal irradiation were numerous. In some cases pregnancy had been considered no contra-indication to treatment. In others, the possible danger of the treatment had been overlooked, or the health of the future child had been entirely disregarded in the interest of the mother. However, in most instances the fetal irradiation had been purely accidental.

In fourteen cases pregnancy took place between treatments in a series of roentgen therapeutic exposures, the ensuing amenorrhea being attributed to the treatment. Here, at a very early age, the embryo was subjected to the full force of the remaining exposures, which were insufficient to produce death or abortion.

One convincing personal observation was as follows: A healthy mother gave birth to three healthy children. The fourth pregnancy was complicated by early uterine hemorrhage, for which a long series of roentgen exposures was given. It was believed at the time that the bleeding was due solely to a submucous myoma. In this case no curettage was carried out preliminary to the use of the irradiation. The child, now five years of age, is microcephalic, with a mental age of little more than two years. Two years after the birth of this child a fifth child was born, who is normal in every respect.

These observations have led to the following conclusions: Pre-conception maternal pelvic therapeutic radium or roentgen irradiation is in no way harmful to the health or development of any subsequent child. This evidence seems to be clear-cut and without exception. During pregnancy diagnostic roentgen irradiation is a safe procedure. However, it would seem wise to delay its use as long as possible, and to use the minimum amount of exposure, especially in the very early months of pregnancy. On the other hand, therapeutic pelvic irradiation during pregnancy is extremely likely to injure the fetus. A preliminary curettage should precede the use of radium or roentgen treatments in women of the childbearing age. By so doing, no unsuspected embryo would be irradiated unwittingly. Every precaution should be taken to make sure that no patient becomes pregnant between any two treatments in a series. Should a fetus become exposed to large amounts of irradiation, the pregnancy should be terminated before the period of viability, whenever possible. Should it become necessary to apply therapeutic pelvic irradiation early in pregnancy, the uterus should be emptied. If the pregnancy is advanced, an induction of premature labor should precede the treatment.

DOUGLAS P. MURPHY, M.D.
Philadelphia.

A NEW SCREEN

Our readers' attention is called to the announcement by The Patterson Screen Company of a new and faster intensifying screen, known as the Patterson Speed Combination. These screens are used in pairs.

one thin front screen and one thick back screen. By reducing the thickness of the front screen its absorption is reduced, thus permitting more of the X-radiation to act on the film direct and to excite the thick back screen. The manufacturer reports that this new Speed Combination retains all of the well-known qualities of the Patterson Cleanable intensifying screen, namely, freedom from grain, freedom from afterglow or lag, with good contrast, plus the added advantage of more speed.

THE INDIANA ROENTGEN SOCIETY

The Indiana Roentgen Society held its fourth annual meeting in Indianapolis on February 21st. E. L. Jenkinson, M.D., of Chicago, was the speaker. The following officers were elected: *President-elect,* L. F. Fisher, M.D., of South Bend; *Vice-president,* H. C. Bernheimer, M.D., of Terre Haute; *Secretary-Treasurer,* J. N. Collins, M.D., of Indianapolis.

PROGRAM OF THE THIRD CONGRESS OF THE PAN-AMERICAN MEDICAL ASSOCIATION AT THE CITY OF MEXICO

Sunday, July 26, 1931, 8:00 P. M.: Inaugural session, attended by the Honorable President of the Republic at the Bolivar Hall of the National Preparatory School.

Monday, July 27, 9:00 A. M.: Practical demonstrations in medicine and surgery in several hospitals and laboratories.

3:00 P. M.: Sessions of different Sections.

7:00 P. M.: Reception at Chapultepec Castle by the Honorable President of the Republic.

Tuesday, July 28, 9:00 A. M.: Practical demonstrations in medicine and surgery in several hospitals and laboratories.

1:00 P. M.: Lunch under the auspices of the Organization Committee at the National Preparatory School.

3:30 P. M.: Sessions of different Sections.

9:00 P. M.: Concert at the Hall of the National Preparatory School.

Wednesday, July 29, 9:00 A. M.: Visit to several branches of the Department of Public Health.

1:00 P. M.: Lunch under the auspices of the Department of Public Education.

3:30 P. M.: Sessions of different Sections.

8:00 P. M.: General Session at the National Academy of Medicine in honor of foreign delegates.

Thursday, July 30, 9:00 A. M.: Sessions of different Sections.

10:00 P. M.: Ball offered by the Department of Public Health.

Friday, July 31, 10:00 A. M.: Meeting of the Committee on Resolutions.

8:00 P. M.: Final general sessions.

A Scientific and Commercial Exposition will take place near the hall where the Sessions are to be held.

For the convenience of those attending the meeting special excursion rates have been arranged with the steamship lines and by railroads. From the Atlantic coast, *via* New York, by the Ward Line: Rate to Mexico City and return, first class, including railroad trip from Vera Cruz to Mexico City, $150.00. From Havana, $115.00.

Information may be obtained from any one of the following:

Dr. Francisco de P. Miranda, Executive Secretary of the Congress, Departmento de Salubridad, Mexico City.

Dr. Conrad Berens, Treasurer of the

Pan-American Medical Association, 35 East 70th St., New York City.

Dr. J. E. Lopez Silvero, Executive Secretary of the Association, Secretaria de Sanidad, Havana, Cuba.

BOOK REVIEWS

PRACTICAL RADIATION THERAPY. By IRA I. KAPLAN, B.S., M.D., Director Division of Cancer, Deartment of Hospitals, New York City; Attending Radiation Therapist, Bellevue Hospital; Lecturer in Radiation Therapy, New York University and Bellevue Hospital Medical College; Director, New York City Cancer Institute, with a special chapter on Applied X-ray Physics by CARL B. BRAESTRUP, B.Sc., P.E., Radiation Physicist, Division of Cancer, Department of Hospitals, New York City; Physicist to Mt. Sinai Hospital, New York City. Illustrated; 354 pages. W. B. Saunders Company, Philadelphia, 1931. Price $6.00.

This volume is a welcome addition to the sparse supply of available texts on radiotherapy, and is, in fact, the only book on the subject. For the teacher of radiation therapy this book will be a ready reference for "collateral reading." For the student it will be a welcome addition to lecture notes, as it makes available in brief yet more than elementary form the practical aspects of the specialty, omitting many theoretical as well as controversial problems. The non-mathematical or non-physical reader will be favorably impressed by the almost total lack of curves and tables. Throughout, the subject of radiotherapy is presented from the point of view of the clinician, treating patients in his every-day practice.

In X-ray therapy the author uses a cross-fire method with repeated divided doses; in radium therapy small doses, heavily filtered, are applied over a long period of time. Such technics as are described in the text will serve as a basis for modifications according to one's experience.

CANCER: ITS ORIGIN, ITS DEVELOPMENT AND ITS SELF-PERPETUATION: THE THERAPY OF OPERABLE AND INOPERABLE CANCER IN THE LIGHT OF A SYSTEMIC CONCEPTION OF MALIGNANCY. A RESEARCH. By WILLY MEYER, M.D. Consulting Surgeon to the Lenox Hill and Post-graduate Hospitals. Pp. 427, with illustrations. Cloth. Price, $7.50. Paul B. Hoeber, Inc., New York, 1931.

This book, based on the author's exhaustive study of the literature since 1917, deals with malignant tumors as an ordinary lawful reaction of tissue to certain systemic and local morbid conditions of the human body; it denies the autonomy of cancer; it asserts the probable unity in character of all types of newgrowths; it recognizes chronic irritation coupled with a predisposition to cancer as the probable cause of all types of tumors, and it holds that persons with a degree of alkalinity of their body fluids higher than normal are predisposed to cancer, those with an acidosis probably being immune to it.

The author states that both the stage of mere presence of cancer susceptibility before there is any local irritation, and the stage of mere presence of local chronic irritation before the patient has, by trauma, acquired a susceptibility, are amenable to prophylaxis by suitable medical means. The stage of active tumor should be treated by a simultaneous attack on both chronic irritations by a correctly selected combination of surgery and medication.

Such a thesis as this, which presents cancer from a quite different angle, deserves serious study and consideration.

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CHEMICAL[1]

An X-ray Investigation of the Crystals of Azobenzene. Mata Prasad. Phil. Mag. [7], 1930, X, 306.

Crystals obtained by slow evaporation from alcohol belong to the monoclinic prismatic class with the lattice constants $a = 12.65$ Å.U., $b = 6.06$, $c = 15.60$, $\beta = 114°24'$, and with the axial ratios $a:b:c = 2.087:1:2.574$. The space group is C_{2h}^5 and requires 4 molecules per unit cell. A remarkable feature is a nearly complete symmetry about the $(20\bar{1})$ plane, both in respect to geometrical relations and to intensities of reflection by corresponding planes.

CHEMICAL ABSTRACTS.

The Influence of Chemical State on Critical X-ray Absorption Frequencies. H. R. Robinson and C. L. Young. Phil. Mag. [7], 1930, X, 71 (cf. Chem. Abs., XVIII, 623).

By an improved satisfactory technic the K levels of Cr in metal and in hydroxide were measured. For Cr metal $\nu/R = 440.99$, agreeing with Lindh's value. $\triangle\nu/R$ for Cr $(OH)_3$ and Cr K levels was found to be 0.5 ± 0.15 Rydberg unit, which is only one-half of Lindh's value. The discrepancy is not due to a dehydration effect.

CHEMICAL ABSTRACTS.

Quantitative Spectroscopic Analysis with Secondary X-rays. G. v. Hevesy, J. Böhm, and A. Faessler. Ztschr. f. Physik, 1930, LXIII, 74.

X-rays, coming from the suitably excited substance, whose composition has to be determined, are analyzed spectroscopically. From the intensities of the emission lines (*e.g.*, K_α) compared with those from a suitable element added to the sample in known quantity, the concentration of the former may be obtained. It has been found that it is necessary to use secondary X-rays to excite the compound to be analyzed, because the ordinary electron impact alters the composition by selective evaporation. The X-ray tube consists of a glowing cathode surrounded by a cylinder with a little carrier which contains the compound to be analyzed and is placed at a short distance from the anticathode supplying the primary X-rays. The intensity of current through the X-ray tube may be considerable (20 ma.), as the ray coming from the cathode must not be centered. A maximum intensity is obtained, when the primary K_α radiation of the anticathode is about 200 X.U. harder than the K absorption edge of the secondary radiator, the continuous spectrum contributing but little to the total radiation. The yield of secondary radiation increases considerably for a given input when the tension is raised; therefore it is advisable to run the X-ray tube with low intensity of current. The intensity of lines, whose potential of excitation does not differ more than 250 X.U., is independent of the tension applied to the tube. The time of exposure was generally 2 to 3 hours, the precision of estimation 0.01, if the element was present in a concentration of 1 per cent. The various sources of error are discussed and a list of elements of reference is given.

CHEMICAL ABSTRACTS.

The Crystalline Structure of Rubidium Azide. Linus Pauling. Ztschr. f. phys. Chem., 1930, Abt. B, VIII, 326.

Polemical. The structure proposed by Günther and co-workers (Chem. Abs., XXIV, 2930) for Rb azide is inconsistent with the known values of atom radii. A structure similar to that of K azide is to be preferred. (*Reply:* P. Günther and P. Rosbaud. Ibid, 329.)

CHEMICAL ABSTRACTS.

X-ray Intensity Measurements with Deformed Crystals. J. Hengstenberg and H. Mark. Ztschr. f. Physik, 1930, LXI, 435 (cf. Chem. Abs., XXIV, 3947).

The application of X-ray intensity measurements to the study of small changes in structure due to mechanical, chemical, thermal, and electrical influences is discussed. Reflections from the cubic faces of sylvine during distortion were obtained with an ionization spectrometer. The increase in (200) and (400) reflections with distortion is due to an increase

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in mosaic-like structure, while diminution in (600), (800), and (1000) reflections is due to deformation of the grating elements. Measurements of line width show disturbances at the slip planes to be local; a 3.8 per cent compression disturbs 2.25 per cent of the atoms with a maximum amplitude ⅛ of the atomic spacing.

CHEMICAL ABSTRACTS.

Intensity Measurements of Diffuse X-rays Reflected from Distorted Sylvine. R. Brill. Ztschr. f. Physik, 1930, LXI, 454.

An apparatus for X-ray measurements, using the Geiger counter method, is described. Measurements show an increase in intensity of diffuse radiation, with deformation of the crystal.

CHEMICAL ABSTRACTS.

New Investigation on the Blue-gray Bright Spot Radiation of the Lilienfeld-Röntgen Tubes. Franz Rother and Willi M. Cohn. Physik. Ztschr., 1930, XXXI, 687.

Visible radiation from Lilienfeld tubes has been studied from 520 to 225 mμ. An intensity maximum occurs at 450 mμ. The radiation could not be resolved into lines or bands and probably extends far into the ultra-violet. The limits and intensity distribution in the continuous spectrum are unchanged with different anticathode materials.

CHEMICAL ABSTRACTS.

Difference in the Intensities of X-ray Reflection from the Two Sides of the III Plane of Zinc Blende. D. Coster, K. S. Knol, and J. A. Prins. Ztschr. f. Physik, 1930, LXIII, 345.

The authors investigate the phase jumps of X-rays of wave length immediately on either side of the *K* absorption edge of Zn in ZnS. The large ratio of the absorption coefficient for the two wave lengths (1:20) occasions a phase displacement of the order of 10°. The observation is rendered possible by the fact that the Zn (111) plane divides the distance between two neighboring S (111) planes in the ratio of 1 to 3. Phase differences of 80° and 110° for first order and 280° and 260° for third order are obtained on opposite sides of the crystal planes between Zn and S components of the diffraction spectra. The resultant difference in intensity is observed experimentally by the use of the Au *L* and W *L* lines.

CHEMICAL ABSTRACTS.

New X-ray Spectrograph with Absolute Zero Determination without a Divided Circle and the Zero Method of Cornu. H. Seemann. Ztschr. f. Physik, 1930, LXI, 416.

A new X-ray spectrograph is described. The method at present almost universally used for the determination of the zero point with the Bragg spectrograph is that due to Cornu (1880). An arrangement is shown for the determination of the zero point by this method, using a pin-hole camera, and the new spectrograph employs a pin-hole camera, but has a new method for determining the zero point. The crystal is mounted on a table on a rod which can rotate through 180° about a vertical axis with accuracy, obviating the use of a divided circle. The rotation can take place in either direction, and the table is accurately fixed in position by contact screws. The principle of the method and the sources of error are discussed.

CHEMICAL ABSTRACTS.

The Determination of the Inner Structure of Liquids by X-ray Means. P. Debye and H. Menke. Physik. Ztschr., 1930, XXXI, 797.

The general method adopted is to start with the experimental results and work toward the structure rather than to assume a structure and derive the theoretical result. Because it is monatomic, liquid Hg was used for the experimental work, and, to simplify the absorption correction, the method of surface reflection was used. The intensity of reflection from a volume of N atoms, if there be no interference between scattered rays, is given by: $I = \frac{1 + \cos^2 \theta}{2} N\psi^2$, where ψ^2 is a function of θ, the angle between the primary and secondary beams, which characterizes the scattering from single atoms (*i.e.*, the so-called atom-factor). The observed results do not agree

with this expression, but may be expressed by $J = \frac{1 + \cos^2 \theta}{2} N \psi^3 E(s)$, where $s = 2 \sin \theta/2$ and $E(s)$ is a purely experimentally determined function of s. The experimental $E(s)$ *vs.* s curve has the form of a damped vibration curve above and below the value $E(s) = 1$, which is approached at high values of s. If W be taken as the probability that the second of two atoms will lie in a volume dV, distant r from the first atom, it can be shown that: $s\,[1 - E(s)] = \frac{2\lambda^3}{d^3} \int_0^a p\,[1 - W(p)] \sin 2\pi s p dp$. Here the variable is not r but $p = \frac{r}{\lambda}$ where λ is the wave length. d is defined by $Nd^3 = V$, where V is the whole volume under consideration. W is not known as a function of p, but, instead, $E(s)$ is known as a function of s. By the methods of Fournier, there results $p\,[1 - W(p)] = \frac{2d^3}{\lambda^3} \int_0^a s\,[1 - E(s)] \sin \pi psds$. The integration may be performed by using the experimental relation between $E(s)$ and s. The problem worked out for Hg shows that certain distances, *i.e.*, 3, 5.6, and 8.1 Å.U., are the most probable distances between atoms. Thus a quasi-crystal structure is present even in a liquid.

CHEMICAL ABSTRACTS.

An X-ray Analysis of the Copper-manganese Alloys. Elis Persson. Ztschr. f. phys. Chem., 1930, Abt. B, IX, 25.

An X-ray crystallographic analysis of the Cu-Mn system is reported and the possibility discussed of a continuous transition of the Cu-phase into the γ-Mn-phase, with increasing Mn content. It is shown that the γ-Mn-phase, ordinarily stable at high temperatures only, becomes stable at ordinary temperatures when alloyed with small quantities of Cu and chilled. The boundary of this phase occurs with concentrations of 83 atomic per cent Mn. The lattice parameter of the Cu-phase increases with increasing Mn content, from 3.008 to 3.74 Å.U. with 50 per cent Mn, then remains constant to the phase boundary. The atomic volume in both simply built phases appears to change continuously over the entire system. Alloys consisting of these phases are formed with considerable expansion.

CHEMICAL ABSTRACTS.

Investigation of Gold-copper Alloys by Means of X-rays. K. Ohshima and G. Sachs. Ztschr. f. Physik, 1930, LXIII, 210.

Above 400° an alloy of Au + Cu crystallizes in the cubic face-centered system (lattice construction $a = 3.866$ Å.U.). Below 400° a tetragonal lattice of AuCu ($a = 3.95$, $c = 3.68$ Å.U.) and a cubic face-centered lattice of $AuCu_3$ occurs. The influence of heating and cooling on the structure is studied by means of rotation and Debye-Scherrer diagrams.

CHEMICAL ABSTRACTS.

Calculation of the X-ray Terms of the Lighter Elements and the Rare Gases from the Optical Potential of Ionization. Werner Braunbek. Ztschr. f. Physik, 1930, LXIII, 154; 718.

The potentials of excitation of K_α of Li, Be, B, and C are obtained from the ionization potentials of Li^+, Be^{++}, B^{+++}, C^{++++}, by taking account of the screening effect of the outer electrons on an electrostatic basis (under very simplifying assumptions). For the heavier rare gases Ne, A, Kr, and Xe the effect of the outer electrons is obtained from the screening number of Sommerfeld's theory of the relativistic doublets.

CHEMICAL ABSTRACTS.

The Lattice Constants of the Elements. William Hume-Rothery. Phil. Mag. [7], 1930, X, 217.

An examination of the measured lattice constants reveals a law of sub-groups which states that in any sub-group of the periodic table, provided that the co-ordination number remains constant, the interatomic distance d is given by the relation $d/n = (1/aZ)^x$, where n is the principal quantum number of the outermost shell of electrons remaining attached to the ions, Z is the atomic number, x

is a constant which is the same for groups with the same number of electrons in the outermost shell, and a is a second constant which in some groups may be connected with the valency. The table gives the values of a and x.

Group	Elements	a	x
IA	Li, Na, K, Rb, Cs	0.0157	0.344
IIA	Be, Mg, Ca, Sr, Ba	0.02265	0.35
IVA	C, Si, Ti, Zr, Hf	0.0465	0.345
VA	V, Ta	0.0628	0.368
VIA	Cr, Mo, W	0.0675	0.376
VIIIA	Fe, Ru, Os	0.05998	0.404
VIIIB	Co, Rh, Ir	0.05689	0.418
VIIIC	Ni, Pd, Pt	0.05808	0.39
IB	Cu, Ag, Au	0.05105	0.393
IVB	Ge, Sn	0.0588	0.33
VB	As, Sb, Bi	0.04753	0.323
VIB	Se, Te	0.0944	0.21
O	Kr, Xe	0.02735	0.348

In some cases the error in the calculated value is 1 per cent but usually the calculated value is in much closer agreement with the determined. The value of x reaches a maximum in Group VIII B. The value of a is not strictly proportional to the valency. The change in co-ordination number does not cause the same percentage change in the different groups; in Group IV its effect is comparatively slight. In the first short period the interatomic distance d is inversely proportional to the atomic number Z; in the second period, d is inversely proportional to Z^2; in the third group, to Z^3; in the fourth group, almost to Z^5. The interatomic distance for Al does not fit into the scheme, indicating that it is probably not fully ionized in the metallic crystal.

CHEMICAL ABSTRACTS.

The Total Reflection of X-rays. Erich Nähring. Physik. Ztschr., 1930, XXXI, 799.

The formula given below is derived: $R = \frac{1 - aq + a^2/2}{1 + aq + a^2/2}$, where R is the ratio of the reflected to the incident intensity, $a^2/2 = q^2 - 1 + \sqrt{(q^2-1)^2 + k^2}$, $q = \frac{\theta}{\theta_0} = \frac{\theta}{\sqrt{2\delta}}$, θ being the angle of incidence and δ the deviation of the index of refraction from 1, $k = \kappa/\delta$, κ being given by $n = (1 - \delta) - i\kappa$. The formula has been verified with experiments in which X-rays between $\lambda = 1.242$ Å.U. and $\lambda = 2.358$ Å.U. were reflected from Ag. The verification was made indirectly, δ being calculated by the Drude-Lorenz formula. It is pointed out that the formula may be used to determine the index of refraction for long X-ray wave lengths.

CHEMICAL ABSTRACTS.

Contribution to the Knowledge of the *K* X-ray Absorption Spectrum of Nickel, Copper, and Zinc. Axel E. Lindh. Ztschr. f. Physik, 1930, LXIII, 106.

The wave lengths of the absorption edges of Ni, Cu, and Zn depend on the chemical state of the elements; the frequency shift amounts for $ZnSO_4$ to 6 v.; for ZnS to 3 v.; for $ZnK_2(SO_4)$ to 6 v. For Ni and Cu the absorption edge is double and possesses fine structure. Apparatus: Siegbahn vacuum spectrograph, calcspar crystal.

CHEMICAL ABSTRACTS.

Determination of the Degree of Polymerization of Some Modifications of Polyoxymethylene by Means of X-ray Methods. Emil Ott. Ztschr f. phys. Chem., 1930, Abt. B, IX, 378 (cf. Chem. Abs., XXIV, 3147).

The method is the same as that used in the previous paper. A high accuracy is claimed. Paraformaldehyde consists of 32 formaldehyde groups, γ-polyoxymethylene of 60 groups, and δ-polyoxymethylene of 24. The length of a formaldehyde group is 1.88 to 1.89 Å.U. It is shown that in highly polymerized substances molecules of equal length form the crystals.

CHEMICAL ABSTRACTS.

A Classification System of the Silicates Based upon Crystal Structure. St. v. Náray-Szabó. Ztschr. f. phys. Chem., 1930, Abt. B, IX, 356.

A new classification system of the silicates based upon their crystal structure is developed. It is based upon the various arrangements of the Si and O atoms. The principal

groups are: (1) (SiO_4) group, orthosilicates; (2) independent groups, with a greater content of Si (*e.g.*, Si_2O_7); (3) SiO chains; (4) SiO planes, and (5) 3-dimensional SiO network lattices. A large number of the silicates are entered into this system in a set of tables. Some of the properties of the silicates are explained on the basis of their structure.

CHEMICAL ABSTRACTS.

The Reflection of X-rays on Absorbing Ideal Crystals. J. A. Prins. Ztschr. f. Physik, 1930, LXIII, 477.

The dynamic theory of X-ray reflection (Ewald-Darwin) is extended to include absorption effects. It results that the intensity distribution inside a spectral line must be unsymmetrical with respect to the angle of regular Bragg reflection (corrected for the refractive index). The total intensity is also perceptibly influenced by absorption.

CHEMICAL ABSTRACTS.

X-ray Determination of the Solubility of Copper in Silver. N. V. Ageev and G. Sachs. Ztschr. f. Physik, 1930, LXIII, 293.

The variations of the lattice dimensions of Ag containing Cu (less than necessary for the formation of mixed crystals) is used as a measure of the Cu content. To obtain reliable results, the surface of the material has to be perfect; this is best obtained by melting the alloy in a vacuum furnace. The solubilities of Cu in Ag at various temperatures are given.

CHEMICAL ABSTRACTS.

The Structure of Chromium Trichloride. Nora Wooster. Ztschr. f. Krist., 1930, LXXIV, 363 (in English).

$CrCl_3$ was obtained by sublimation in dry Cl at about 1000° in the form of extremely thin hexagonal plates, violet in color. It is optically negative and the Becke line (seen with great difficulty) suggests an index between 1.63 and 1.64. Specific gravity was determined as 2.87, which is higher than the usual value (2.77). A combination of X-ray methods gave the following results: space group D_3^3, or D_3^5, unit cell contains 6 molecules; $a = 6.02$ Å.U. and $c = 17.3$ Å.U. These data differ from those of Natta (Chem. Abs., XXI, 2406). The Cl atoms have a cubic close-packed arrangement, and each Cr atom is surrounded by 6 Cl.

CHEMICAL ABSTRACTS.

The Absorption of X-rays in Gases and Vapors: I.—Gases. J. A. Crowther and L. H. H. Orton. Phil. Mag. [7], 1930, X, 329.

New measurements using Cu *K* radiation gave the following results:

	u	I_v	I_m
Air	9.46	1.000	1.000
N_2	7.43	0.743	0.766
O_2	11.14	1.438	1.301
CO_2	9.30	1.530	1.006
CH_2:CH_2	4.32	0.508	0.524
H_2S	82.7	14.96	12.58

u = mass absorption coefficient.

I_v = relative ionization for equal volumes.

I_m = relative ionization for equal masses.

The fraction of absorbed X-ray energy utilized in producing ionization is approximately constant for the majority of gases except N_2, for which it is 15 per cent greater.

CHEMICAL ABSTRACTS.

The Action of X and Gamma Radiation upon Aqueous Solutions of Iodine and Potassium Iodide. G. Harker. Med. Jour. Australia, Dec. 20, 1930, II, 817.

It is shown that Bordier's statement that iodine in aqueous solution disappears under the influence of X-rays is erroneous, his effect being due to the interaction between the iodine solution and the paraffin which he used to coat the cardboard box of his experiments. The radiation employed was derived from a Coolidge water-cooled therapy tube energized at 40 K.V. constant potential, and 2.5 ma. at 12 cm. target-object distance for

a period of one hour. No filtration is mentioned. Two tubes of iodine solution of concentration such that 3 c.c. reacted exactly with 0.20 c.c. N/500 sodium thiosulphate solution were exposed. One tube was shielded by lead (thickness not stated), the other with a sheet of black paper. At the end of one hour, each tube required 0.16 c.c. of N/500 sodium thiosulphate solution for exact reaction. That is to say that there was no difference between the irradiated and non-radiated solutions. Starch iodine solution was also unaffected by X-rays in the above dosage. It is not made clear that thermal effects were entirely eliminated by the method of using the screened control—and temperature effects have been a fallacy in many biological experiments with X-rays.

The author mentions, however, that using 65 K.V. and 2.5 ma., the solution, "unprotected by lead, was exposed to a higher temperature, with a small increase in the loss of iodine caused by reaction with water." He does not show that the effects of X-rays and raised temperature are not antagonistic. More definite are the results with γ-rays, which also do not affect iodine solution (6 mg. needles filtered with 0.5 mm. of platinum for five days in a solution containing 0.126 gm. of iodine per liter).

Kailan's result that γ-rays decompose solutions of potassium iodide were confirmed, and shown to hold for X-rays also. Attention is drawn to the marked acceleration of the action of the rays produced by the addition of small amounts of acid.

J. G. Stephens, M.B. (Syd.), D.M.R.E.

DOSAGE

Application and Dosage of Bucky's "Borderline Rays" in Ophthalmology. Ilona Krasso. Strahlentherapie, 1930, XXXVIII, 358.

The author studied the effect of X-rays of long wave length on the eyes of rabbits. He found that doses as high as 4,000 r produce only an injury to the cornea but do not affect the lens. He feels that the tolerance dose for borderline rays is about twice as high as for ordinary roentgen rays. His therapeutic studies on human eyes showed similar relations. From 50 to 200 r of a half value layer in aluminum equal to 0.02 mm. were given in the average case. The treatment can be repeated at intervals of from two to fourteen days, up to five times. Satisfactory results were obtained in the following diseases: erosio corneæ; herpes corneæ; keratitis filamentosa, dendritica and punctata superficialis; rosacea of the cornea, infiltrated erosions; superficial ulcer, episcleritis, and scleritis.

Ernst A. Pohle, M.D., Ph.D.

A Biologic Unit in the Dosage of Roentgen Rays. E. Björling. Strahlentherapie, 1930, XXXVI, 751.

This paper is based on the assumption that 1 r produces different biologic effects if different wave lengths are used. Measuring methods both for quality and quantity of roentgen rays have been worked out by the author, permitting the expression of the dose in "bio-r." This is the unit of his biologic measuring system which takes the wave length dependence into consideration. The details of the technical procedure and also its theoretical foundations must be looked up in the original.

Ernst A. Pohle, M.D., Ph.D

Maximum Dose, Fractional Treatment, or Saturation Method? Studies on Mice with Carcinoma. Jens Juul. Strahlentherapie, 1930, XXXVIII, 623.

The author studied the effect of roentgen rays and radium applied according to the single massive-dose method, the fractional, and saturation-dose method on transplanted tumors in mice. The technic is as follows: 220 K.V., 2.8 ma., 5 mm. Al, 2.3 cm. F.S.D., 1 S-N. = 6 min., 3½ S-N. equal to 1 E.D. The exposures were given as follows: 6 S-N. in one sitting, 3 × 2 S-N. twice weekly, 3 × 2 S-N. once every 2 weeks, and 3 × 2 S-N. once every 3 weeks, or 6 S-N. in one sitting, 3 × 2 S-N. applied twice daily and 3 × 2 S-N. on three successive days. In both groups, the single-massive dose had the most pronounced effect. In observing the epilation following the treatment, it appeared, however, that 6 S-N. given in one sitting always epilated,

while 3 × 2 S-N., applied every twelve hours, rarely did so. Another series received 6 S-N. in one sitting, 2 S-N. six times, applied twice weekly, and then 5 S-N. in one sitting followed by 4 × 2 S-N., given once a week.

The results demonstrated that the dose on the skin could be higher with the protracted fractional method without causing injuries, and that the therapeutic effect on the tumor was better than that of a single-massive dose. Similar experiments carried out with radium lead to the conclusion that a more severe reaction follows the application of a high intensity in a short time than the application of a small intensity over a long period. Since the skin and tumor tissue apparently cumulate radiation in a different manner, the fractional dose method is advantageous. It permits the application of a higher total dose within the tumor without damaging the skin.

ERNST A. POHLE, M.D., Ph.D.

Roentgen Dosage in Practice. Th. C. Neeff. Strahlentherapie. 1930, XXXVIII, 322.

The author visited fourteen Radiological Institutes in Germany, Austria, Switzerland, France, and Belgium, and had his ionization instrument calibrated in r-units. It appeared that the calibrations carried out in Germany differed as much as 16 per cent, while the highest variation among all calibrations amounted to 18 per cent. These discrepancies are high if one considers the fact that the measuring instruments available to-day are accurate within 1 per cent. The various precautions necessary to calibrating a dosimeter are discussed in detail; the conditions under which the measurements are carried out are often responsible for the differences in the results. Although the variations found do not interfere with the practical work, the investigator must demand a higher degree of accuracy. Steps are being taken by the Standardization Committee of the German Roentgen Ray Society to remedy the situation.

ERNST A. POHLE, M.D., Ph.D.

GALL BLADDER (NORMAL AND PATHOLOGICAL)

Intravenous Cholecystography and Liver Function Determination: Clinical and Roentgenological Value. Sydney R. Miller and Charles A. Waters. Southern Med. Jour., December, 1930, XXIII, 1079.

The authors add the weight of their experience to the intravenous method of administering the dye, and contend that it is essentially devoid of dangerous reactions, is not time-consuming or complicated, and is more dependable than the oral technic. This series includes cases with severe jaundice, due to cholangeitis, common duct obstruction, and severe liver damage following arsphenamine treatment, without any unpleasant reactions. In using the intravenous technic as a liver function test, from 12 to 15 c.c. of blood are withdrawn one-half hour after the administration of the dye, and tested colorimetrically for the percentage of dye retained. The authors' series covers 131 patients, 24 of whom came up for operation. Of these 24, the operative findings agreed with the X-ray findings in 20 cases. Of the 107 patients not operated upon, the clinical symptoms and X-ray findings agreed in 95 cases, or 88 per cent.

The authors conclude that this series is but another confirmation of the extreme value of cholecystography as a method of detecting functional abnormalities, and hence, presumably, diseased conditions of the gall bladder. They contend that the failure of the gall bladder to visualize by the oral method must be checked by the intravenous route, particularly in cases in which the clinical picture is not a clear one of gall-bladder disease.

W. W. WATKINS, M.D.

Gallstones in the Ampulla of Vater. E. Starr Judd and James M. Marshall. Jour. Am. Med. Assn., Oct. 11, 1930, XCV, 1061.

Fenger, many years ago, described the symptoms of stone lodged in the ampulla, the "ball-valve stone of Fenger." A series of 160 cases were reviewed in which one or more stones were found in the ampulla at operation, and in which the stones were not found in

the hepatic or common bile ducts. In 45 per cent of the series, one or more operations had been performed in the biliary system. In several cases, as many as three or four operations had been performed. Periods of relief varied. The most characteristic feature of stone in the common bile duct is the intermittent nature of the symptoms. Osler stressed paroxysms of colicky pain, chills and fever, and jaundice, followed by intervals of comparative or complete freedom from symptoms—or classic symptoms. Duodenal drainage affords a valuable clue as to whether or not bile is passing from the duct into the duodenum. The technic of operation is discussed and some interesting observations at operation review the occurrence of single and multiple stones, and the occurrence of stones in the gall bladder, coincidently with stones in the duct.

CHARLES G. SUTHERLAND, M.D.

Gall-bladder Visualization in Jaundiced Patients. Hillyer Rudisill. Jour. Am. Med. Assn., Nov. 8, 1930, XCV, 1425.

It is quite generally believed that it is not desirable to advise cholecystography in jaundiced patients. Ten jaundiced patients have been among a group coming in a routine manner for cholecystography. In all but one, the examination revealed useful information without ill-effect to the patients. There is no contra-indication to attempted gall-bladder visualization in obstructive or extrahepatic jaundice. In eight of ten jaundiced patients submitted to gall-bladder dye injection, the clinical diagnosis was catarrhal jaundice.

It is advisable to give intravenous tetrathalein sodium solution to jaundiced patients as a possible means of helping to differentiate the causes of jaundice.

CHARLES G. SUTHERLAND, M.D.

Cholecystographic Diagnosis of Papillomas of the Gall Bladder. B. R. Kirklin. Am. Jour. Roentgenol. and Rad. Ther., January, 1931, XXV, 46.

Although benign tumors of the gall bladder are rated as rare by pathologists, the Mayo Clinic, during the last seventeen years, has found papillomas in 8.5 per cent of more than 17,000 gall bladders removed surgically. The clinical and pathological significance of papillomas has not been fully determined, but in many cases at the Clinic, even though they were small and not accompanied by definite cholecystitis, they seemed to have a causative relation to the patient's symptoms, for cholecystectomy was followed promptly by relief. By the use of painstaking cholecystographic technic, the author is able to differentiate, roentgenologically, between papillomas and stones. On that basis the diagnosis of papillomas has been ventured in 20 cases, in four of which the diagnosis was confirmed by operation. The especial characteristics, as seen on the roentgen film, in contrast with non-papillomatous lesions, are: unchanging position within cholecystic shadow; small evenly rounded defects, usually marginal and never at the fundic pole; in most instances only one or two visible defects, but when multiple never closely aggregated; often seen only at the twentieth hour (two hours after a fatty meal).

The author concludes that, although only a few cases are presented, the results thus far obtained may have a broad bearing in the future on the diagnosis of tumors of the gall bladder.

J. E. HABBE, M.D.

Cholecystography by Means of the Oral Administration of the Dye. Bruno Thom. Röntgenpraxis, Jan. 1, 1931, III, 17.

The results of oral cholecystography in 702 cases are evaluated by the author. Only after Kirklin showed that the addition of unfermented fruit juice makes the absorption better, and after a preparation was offered which contained the fruit acid, oral tetragnost (Merck), could this method compete with the intravenous method. In about 15 per cent of all cases in which the oral administration is used, may one expect nausea, vomiting, or diarrhea. Taking the dye only one hour after eating three egg-yolks seems to decrease the nausea, while giving it on an entirely empty stomach seems to induce vomiting much more frequently.

In 73 cases, both the intravenous and oral administration were used. In 8, there was

a definite filling after taking the dye by mouth, while the intravenous method did not show any filling; in 12, the contrary took place. Since intravenous cholecystography usually gives a denser shadow, one should realize that too dense a shadow may obscure small stones, as has happened in this series. A non-functioning gall bladder may be found occasionally in other diseases, probably caused by secretory disturbances of the liver and gall bladder, when the gall bladder itself is normal.

Orator found a non-functioning gall bladder in 60 per cent of 25 cases of gastric or duodenal ulcer; Grebe found 26 per cent. These percentages, however, cannot be correct, in the author's opinion. In order to have a more definite knowledge on this question, a large number of ulcer cases should have a cholecystographic examination. The dye test may show a non-functioning gall bladder also in patients with an exophthalmic goiter or diabetes. According to most writers, a non-filling gall bladder is found in patients with exophthalmic goiter in about 50 per cent of all cases. The author examined six cases and found a non-functioning gall bladder in all of them. The question, whether or not the gall bladder empties itself by muscular contraction, seems definitely settled in the writer's opinion. He has seen definite waves of contraction in a series of films. A roentgenologic visualization of the choledochus is very rare, if the usual technic is used. The author has been able to show it fairly regularly after giving Cholotonon, a preparation which is supposed to contain the hormones of the liver and the extrahepatic system.

H. W. Hefke, M.D.

GASTRO-INTESTINAL TRACT (DIAGNOSIS)

Enemata: From the Anatomical and Physiological Standpoints. Silas A. Lewis. California and Western Med., January, 1931, XXXIV, 31.

The author discusses the anatomy of the colon, emphasizing the character of the bowel, especially the angulation at the hepatic and splenic flexures, and the increased musculature of the descending colon. He also emphasizes the amount of residual fluid found after evacuation of the enema. The giving of large enemas dilates the cecum and allows the enema to flow into the ileum, carrying with it colonic bacteria. This, the author believes, may be etiologic of ileo-colitis. Large enemas weaken the musculature of the colon and are pocketed behind the splenic and hepatic flexures. The article is illustrated with numerous X-ray cuts.

Francis B. Sheldon, M.D.

Peptic Ulcer: The Diagnostic Value of the Roentgen Ray before and after Treatment. Edward S. Emery, Jr., and Robert T. Monroe. Am. Jour. Roentgenol. and Rad. Ther., January, 1931, XXV, 51.

The authors fully recognize the value of the roentgen examination in the diagnosis of peptic ulcer (in 93 per cent of a series of 510 cases in which the diagnosis was definitely established, an ulcer was demonstrated roentgenologically), but upon analysis of a large series of case records from the Peter Bent Brigham Hospital in Boston, they find the same method of examination much less reliable and helpful in following the course of the lesion. Because after long continued study of many ulcer cases, some showed stationary conditions for years, the opinion is ventured that it may be foolish to advise severe and time-consuming surgical or medical treatment, merely because the presence of a gastric or duodenal ulcer can be shown. As regards the X-ray diagnosis of ulcer, the authors believe the errors in diagnosis to be chiefly those of omission, but even these were found to be surprisingly few.

Retention, determined by the six-hour roentgen examination, was found to be present in 50 per cent of gastric and 44 per cent of duodenal ulcers, but in the majority of the cases, it was small (a trace to 20 per cent). Retention determined clinically agreed closely in 67 per cent of the cases, but in the remaining 33 per cent, the clinical and roentgen retention differed as to the degree present. Hence one would not be justified in advising surgery for relief of obstruction before checking the retention reported present by the roentgen study with that noted by the clinical examination. An analysis of 140 duodenal ulcer cases, treated by several forms of med-

ical and surgical measures, revealed the duodenal deformity persistent upon re-examination roentgenologically following treatment in 94.3 per cent. The small percentage of cases showing disappearance of the duodenal deformity were in every instance treated only medically. In five patients with combined gastric and duodenal ulcer, all but one showed disappearance of the gastric deformity under treatment, but the same number showed a similar or increased deformity of the duodenal bulb.

The authors conclude with the statement that, in their opinion, a diagnosis of healed duodenal ulcer is at present impossible by roentgen examination, and add, rather pessimistically, that this lesion is a very chronic one, rarely cured by treatment.

J. E. Habbe, M.D.

The Differential Diagnosis of Benign Tumors of the Stomach and Intestines. Franz Schmitz. Röntgenpraxis, Dec. 15, 1930, II, 1118.

The roentgenologic findings and clinical history of a patient who had two rather large submucous myomas of the stomach are described. Most benign gastric tumors are polyps, myomas being distinctly rare. Another case is described in which multiple small filling defects were found in the esophagus. On account of their multiplicity and well defined outlines, a benign polyposis was diagnosed. The patient died, with increasing obstruction and cachexia. Inflammatory tumors may simulate a malignancy in the colon, especially when associated with diverticulitis. Even a careful examination of the "mucosa relief" does not always assist in arriving at a positive diagnosis, and, therefore, repeated examinations must be made.

H. W. Hefke, M.D.

Roentgen Diagnosis of Gastric Syphilis. Leon T. LeWald. Jour. Am. Med. Assn., Jan. 17, 1931, XCVI, 179.

The author made his first roentgenologic diagnosis of gastric syphilis in 1913. The diagnosis was made prior to the examination of the blood, which was later reported as giving a four plus Wassermann reaction. The diagnosis was confirmed by operation. The case was evidently one of congenital syphilis and has been re-examined several times, the last time in June, 1930. A second case of congenital syphilis was seen later in 1913. In September, 1916, 11 additional cases were reported by the author and about 40 additional cases have come under his observation, in which the diagnosis of gastric syphilis has been made or suggested from the roentgenologic appearance. The more interesting of these cases are reviewed. Syphilis of the stomach is relatively more frequent in occurrence than the number of reported cases would appear to indicate, and the importance of a correct diagnosis of this condition is not yet thoroughly appreciated. Congenital cases may escape diagnosis owing to the fact that syphilis may not be suspected, and other syphilitic manifestations may be lacking. Diminished acidity of gastric contents and the absence of free hydrochloric acid are explained in some cases by the rapid emptying of the stomach and in others by the involvement of the acid-producing portion of the stomach.

It is inadvisable to make a diagnosis of carcinoma of the stomach or subject a patient to operation for supposed carcinoma of the stomach, especially when the possibility of an extensive resection is under consideration, without submitting the patient to a roentgen examination by a roentgenologist of sufficient experience to enable him to make a differential diagnosis between gastric carcinoma, linitis plastica, ulcer, or syphilis of the stomach. In doubtful cases a diagnosis may be established by determining improvement in the appearance of the stomach on roentgen examination after antisyphilitic treatment has been actively undertaken, especially after using arsphenamine, mercury, and iodides. In some cases surgical intervention may be necessary because of extreme cicatrization, especially involving the pyloric end of the stomach, producing an obstructive lesion. Extensive resection of the stomach should be carefully avoided when the diagnosis of gastric syphilis has been made roentgenologically, or when suspected by the surgeon because of peculiar types of gastric

lesions which differ from those usually encountered in ulcer or carcinoma of the stomach. Syphilitic deformity of the stomach has been proved roentgenologically to disappear after prolonged antisyphilitic treatment, and no recurrence of symptoms has occurred in a series of cases studied over a period of from ten to seventeen years.

CHARLES G. SUTHERLAND, M.D.

Syphilis of the Stomach. Luther L. Hill, Jr. Southern Med. Jour., December, 1930, XXIII, 1153.

At present there is a marked variation in the criteria for a diagnosis of gastric syphilis, and, doubtless, many cases reported have been confused with other conditions. Even among pathologists there is considerable difference of opinion as to the anatomical evidence which warrants such a diagnosis. The criteria set forth by Harris and Youmans as being "reasonably conclusive" are: "(1) evidence of organic disease of the stomach, which, on X-ray examination, is indistinguishable from carcinoma; (2) a comparatively young individual; (3) the presence of other evidence of syphilis; (4) a qualified improvement under antisyphilitic treatment; (5) in operative cases, demonstration of tissue changes compatible with syphilis." The demonstration of the lesion in the stomach by the X-ray is essential, because systemic syphilis may give symptoms of stomach disorders, without organic involvement of the stomach.

W. W. WATKINS, M.D.

Gastric Syphilis: Observations Based on Ninety-three Cases. George B. Eusterman. Jour. Am. Med. Assn., Jan. 17, 1931, XCVI, 173.

The traditional conception of late or tertiary lesions of acquired syphilis of the alimentary tract is confined almost entirely to those of the mouth, nasopharynx, and rectum. In the light of our present knowledge, based on authentic pathologic and clinical investigations, with the possible exception of the esophagus, which seems rarely affected, it is still an unsettled question as to which organ of the gastro-intestinal tract is most frequently involved. Undoubtedly, routinely made serologic and roentgenoscopic examination of patients with digestive disturbances has led to the eventual disclosure of gastric lesions of syphilitic origin and to a better knowledge of their incidence in the living subject. Gastric syphilis is common in China. The incidence in Russia seems to be high. Then, in order of probable frequency, come France, Austria, Germany, and England.

The diagnostic aspects of gastric syphilis may be summarized as follows: The majority of the patients fell into the period from the second to the fourth decade of life, the average age was about 36 years; the gastric disturbances were usually marked and progressive, with an average duration of two years; the symptoms depended, in a large measure, on the site and extent of the lesion and the existing complications; achlorhydria, or subacidity, especially the former, was the rule; palpable mass, retention, nausea, anorexia, anemia, cachexia, gross hemorrhage, and occult bleeding were infrequent, in contrast to their incidence in carcinoma, a disease in which the laboratory data usually simulated those of gastric syphilis.

The roentgenologic manifestations, although not pathognomonic, were those of circumscribed or diffuse involvement of the gastric wall, rather than an intrusion into the lumen by a growth, which produced contraction of variable degree, stiffening, lessened mobility, and absence of peristalsis. The pylorus was usually gaping; less frequently it was obstructed. The diagnosis was often inferential because of the frequent absence of a palpable mass corresponding to the position of a filling defect, and because of the disproportion between the patient's general condition and the extent of the gastric involvement, as revealed by the roentgenoscopic examination. In 70 per cent the lesion was of the prepyloric type, the defect was concentric, rather symmetrical, and of variable extent upwards. In 22 per cent the lesion was of the median or dumb-bell, hour-glass type, and in the remainder (8 per cent) the involvement was diffuse.

Modern scientific methods of diagnosis and

treatment, coupled with the knowledge gained from histopathologic study of resected material in cases in which operation had been performed erroneously for carcinoma, reveal the fact that gastric syphilis is not as rare as is generally supposed. The disease simulates gastric carcinoma more frequently than any other lesion. In all cases of syphilis in which a demonstrable gastric lesion is present, regardless of the roentgenologic type or extent, the condition should be regarded as syphilitic until it is proved otherwise.

CHARLES G. SUTHERLAND, M.D.

GENITO-URINARY TRACT (DIAGNOSIS)

Unusual Duplication of Renal Pelvis. Hermon C. Bumpus, Jr. Jour. Urology, January, 1931, XXV, 39.

Until recently, whenever duplication of the kidney pelvis occurred, the division was considered transverse, one pelvis being situated above the other. This view was maintained by Young and others. Potter and Sexton believed the division might be longitudinal as well, with one pelvis anterior and one posterior, and demonstrated a case by which their opinion was confirmed. The author reports another case of longitudinal fission, with one pelvis superimposed on the other. A supernumerary kidney must be considered.

DAVIS H. PARDOLL, M.D.

A Giant Ureteral Calculus. Frank S. Patch. Canadian Med. Assn. Jour., October, 1930, XXIII, 553.

This is a case report from the urologic service of the Montreal General Hospital. The clinical history is as follows: male, aged 35; pains in left groin; thick urine; history of a blow in the pit of the stomach four months previously; temperature 104°; urinary frequency and burning; urine contains pus. X-ray examination showed a large oval shadow in the left pelvis, in the anatomical situation of the ureter. Cystoscopic examination showed a regular, rounded bulging on the left side of the bladder. Ureteral catheter was obstructed 2 cm. from the mouth of the left ureter. The ureterogram of this side showed the fluid leaving the catheter, and a thin film spreading around the lower half of the shadow. The diagnosis was left ureteral calculus. At operation the left ureter was exposed extra-peritoneally—greatly dilated, the walls thickened, with a kink just above the brim of the pelvis. A large stone was felt low down in the ureter. An incision was made in the ureter above the calculus, the stone removed by forceps, with great difficulty, and a drainage tube left in the upper ureter, but a probe could not be passed into the bladder. Subsequently there was very little urine drainage through the tube, and no indigo-carmine, injected intravenously, appeared during a five-hour observation.

After two weeks cystoscopy was again performed, and the ureter was found still obstructed in its lower portion. A pyelogram, secured by injection through the drainage tube, showed a greatly distended ureter and kidney pelvis. One week later left nephrectomy and ureterotomy were performed, the ureter being removed down to the bladder. The kidney was found markedly atrophied, and the pelvis and ureter greatly dilated. The report is well illustrated by X-ray reproductions.

L. J. CARTER, M.D.

Clinical Application of Bladder Tumor Pathology. Paul W. Aschner. Am. Jour. Surg., October, 1930, X, 67.

The author arrives at the following conclusions, after a very comprehensive study of 285 cases of bladder tumor pathology. In 97.5 per cent of the cases, reliable information regarding the character of bladder tumors is obtained by cystoscopic biopsy. It is chiefly in multiple tumors and papillomatosis that unavoidable failures occur. Biopsy alone does not determine prognosis in cases of malignancy.

In cases in which cystoscopic examination reveals papilloma and there is response to fulguration, a biopsy diagnosis of malignancy is a signal for more radical therapy (radium or surgery). General tumor terminology and clinical requirements may be applied to bladder tumors in a harmonious manner. They may be either benign or malignant. Cell-grading, as a basis for classification, is not as prac-

tical for clinical purposes, and the prognosis, based on this, does not coincide with the late results in this series. A more reliable guide to the gravity of the situation is the presence or absence of infiltration. Resectability depends upon the site of the malignant tumor and influences prognosis materially. Segmental resection of the whole thickness of the bladder wall is the procedure of choice in cases which are considered surgical, following a biopsy diagnosis of carcinoma. Recurrence often results if this procedure is not performed in pedunculated tumors, as gross inspection cannot reveal stalk invasion and tumor cells in the blood vessels at the base.

That papillary carcinoma develops from papilloma in a considerable percentage of the cases is doubtful from clinical observation, yet histological studies tempt one to believe so. Only 30 out of 138 papillary carcinomas failed to show evidence of infiltration. There is a probability that this may represent an earlier stage in the development of the disease. Since other lesions may stimulate neoplasms very closely, it is essential to obtain a biopsy specimen before undertaking radical surgery.

DAVIS H. PARDOLL, M.D.

Intravenous Urography (Swick Method). Leopold Jaches. Jour. Am. Med. Assn., Nov. 8, 1930, XCV, 1409.

Continuing the essay of Swick, the author discusses the roentgenologic features. The present substance, under normal conditions, is excreted as such through the urinary tract within from eight to twelve hours to the extent of from 85 to 95 per cent. Iodism has never been observed. Its tolerance is exceedingly great. From 45 to 65 per cent of the substance is normally excreted during the first two hours. For this reason the roentgenograms show their greatest intensity during this period. The roentgenologic technic is discussed in detail. A comparison of the intravenous method with the cystoscopic or retrograde method favors the intravenous method, with an added advantage that it demonstrates not only the anatomy of the urinary tract, but also its function.

CHARLES G. SUTHERLAND, M.D.

Experimental Research Concerning Intravenous Pyelography in Pathological Conditions of the Kidneys. Gerhard Gabriel. Acta Radiologica, 1930, XI, Fasc. 5, No. 63, p. 500.

By radiation of the kidney and by ligation of the ureter, renal artery, and renal vein, the author has attempted to study in experimental animals the pathological conditions which disturb the normal appearance of the urinary tract in intravenous pyelography.

He concludes as follows from these studies:

1. Damage of the kidney by radiation delays the excretion of the dye.
2. Tumors of the kidney which have destroyed a considerable portion of the parenchyma also delay excretion.
3. In chronic blocking of the kidneys excretion is so slow that good visualization of the urinary tract is impossible.
4. Interference with the arterial blood supply of the kidney delays the excretion of the dye.
5. Purulent infections of the renal pelvis and kidney proper affect greatly the excretion of the dye.
6. In paranephritic abscess visualization occurs as long as the renal parenchyma is not involved.
7. Any condition, whether in the ureter or outside it, which delays the passage of the urine from the kidney to the bladder, leads to stasis in the renal pelvis and delayed filling.
8. The normal rapid excretion of the dye is delayed by temporary compression of the ureter. Such a condition sometimes is seen in pregnant animals. Artificial compression from outside the body may be used by the roentgenologist for this purpose; this procedure often results in excellent visualization of the kidney pelvis.

ALAN L. HART, M.D.

A New Urographic Medium: Emulsified Campiodol (an Iodized Rapeseed Oil). Adolph A. Kutzmann. Am. Jour. Surg., November, 1930, X, 320.

Campiodol is an iodized oil containing approximately 44 per cent elemental iodine. To adapt it to urographic use, a stable emulsion

was made using campiodol, acacia, and distilled water. This results in a mixture containing from 10 to 11 per cent elemental iodine, making it equal to sodium iodide for roentgenographic use. Emulsified campiodol, as a urographic medium, is miscible with water. It is inert, non-toxic, non-irritating, and casts excellent roentgenographic shadows, as to detail and intensity, in all parts of the urinary tract. The author has used it in over two hundred and fifty cases and believes it to be superior to sodium iodide for this purpose.

HOWARD P. DOUB, M.D.

Excretion Pyelography with Abrodil. H. Bronner and J. Schueller. Surg., Gynec. and Obst., February, 1931, LII, 254.

The sodium salt of iodo-methane-sulphonic acid, a white crystalline powder, is called "abrodil." This substance, when injected intravenously (20 grams dissolved in 70 to 100 of distilled water), produces a solution which can be sterilized, and its iodine is tightly bound and is not split off within the body. It can be used in the above percentage in pregnant women and tuberculous patients, and appears to be contra-indicated only in those patients suffering from the severest form of kidney insufficiency. This method can be used in ambulatory patients, and also has been used in 15 to 20 per cent solutions for retrograde pyelography. X-ray films are best taken during the first hour after the injection.

DONALD S. CHILDS, M.D.

Interpretation of Double Ureters. Leonard P. Wershub. Am. Jour. Surg., October, 1930, X, 122.

The author reports several interesting anomalies of the ureter. Modern diagnostic methods in urology have been responsible for the increase in the number reported. The embryologic defects are represented by their anomalies. Surgical complications are more prone to develop in these conditions because of the possibility of interference with urinary function, yet this does not imply that all anomalies are pathologic. Only in cases in which there is obstruction and subsequent infection does renal impairment follow. Duplication may not be complete, the fusion occurring either high up or low down. An abnormally located pelvis, in relation to the kidney itself on pyelography, should lead one to suspect an anomaly.

In duplication of ureteric orifices one should be careful in differentiating the urine recovered by catheterization, as one lobe may furnish a clear specimen, while the other may be cloudy. Clear urine obtained subsequent to a previous specimen of cloudy urine does not necessarily imply a spontaneous recovery from kidney infection.

DAVIS H. PARDOLL, M.D.

The Demonstration of the Kidneys with Abrodil, and Some Remarks about the Roentgen Stereoscopy of the Kidney. W. Teschendorf. Röntgenpraxis, Oct. 15, 1930, II, 937.

The author, although not optimistic about the demonstration of the urinary tract by intravenous injection of dyes when he began to use them, comes to the following conclusions: (1) The demonstration of the urinary tract, by means of the intravenous injection of dyes, has the advantage that it is a functional test at the same time (specific gravity test); (2) it makes an examination possible in cases in which introduction of ureteral catheters is not possible; (3) the danger of infection is avoided; (4) it allows the simultaneous demonstration of both kidneys, often not possible by means of the ureteral catheter; (5) it is much less severe for the patient than a cystoscopy.

Uroselectan and abrodil (a new German preparation) have been used. Abrodil is entirely non-toxic, as is uroselectan. Only 20 gm. of the substance are necessary, diluted in 50 c.c. of distilled water. An increase in the amount of abrodil does not increase the density of the shadow, even 10 gm. being sufficient in some cases. Dryness in the mouth and a flushed face are observed after the injection, but are absent when the 20 gm. are

diluted in 100 c.c. of distilled water. A compression bag over the ureters in the sacro-iliac region seems to improve the results. A good filling of the kidney pelvis, however, even with the best technic, is not always possible. Stereoscopic examination of the urinary tract, demonstrated by uroselectan and abrodil, has been a great help, the rather soft shadows of the pelvic and ureteral filling being more marked in the stereogram by the addition. The introduction of a ureteral catheter, with stereoscopic films, seems better than abrodil or uroselectan and stereograms. The introduction of abrodil in a 40 per cent solution into the duodenum did not give a contrast shadow of the pelvis and ureters, probably because the solution was too concentrated. Films of the arm and shoulder, taken during the intravenous injection, show all the veins of the arm up to the subclavian vein. Abrodil might well be used for the demonstration of blood vessels.

H. W. Hefke, M.D.

Roentgen-ray Diagnosis of Urologic Conditions. H. King Wade and H. Clay Chenault. Jour. Arkansas Med. Soc., October, 1930, XXVII, 97.

These authors summarize a short general paper on the use of the X-ray in urology, as follows: (1) Urology and roentgenology are inseparable from a urologic diagnostic standpoint; (2) modern urologic X-ray equipment is essential in the diagnosis of urologic conditions; (3) the urologist may assist in the diagnosis of obscure surgical and gynecological conditions by means of the roentgen ray; (4) the X-ray is invaluable in the pre-surgical location of calculi in the genito-urinary tract.

W. W. Watkins, M.D.

Bone Suppuration and Renal Calculi in Children. Milton C. Borman. Am. Jour. Dis. Child., October, 1930, XL, 804.

A case of a boy, aged 9, with bilateral renal and ureteral calculi, and an overwhelming osteomyelitis of the tibia, is reported. Hematuria was the only clinical evidence of urolithiasis. The calculi remained unsuspected and undiscovered until necropsy, at which time they were found to be composed of practically pure calcium phosphate with a small amount of organic matter. Less than 50 per cent of urinary calculi are so composed, according to Thomson, and in a series of 203 cases, reported by Thomas and Tanner, only one showed calculi in both kidneys and ureters.

The author reviews references in the literature concerning the incidence of renal calculi in infancy and childhood, and their frequency in patients with fractured spine and with bone suppuration. He states that the calculus formation in his case was probably definitely dependent on the osteomyelitis and was not simply an associated incidental condition. It is important, therefore, to suspect urolithiasis in cases of bone suppuration in children and adults.

F. B. Mandeville, M.D.

Para-urethritis. Sidney J. Silbar. Jour. Urology, January, 1931, XXV, 85.

The author finds that para-urethral ducts are a cause in the chronicity of gonorrhea. They may act as foci of infection and cause a recurrence of an infection. The infection may linger within their portals over a long period of time. Their occurrence, while uncommon, is greater in cases of normal meatus than in hypospadias.

An indispensable aid in recognizing and locating the para-urethral ducts and their ramifications is the use of the roentgenogram. An opaque solution injected into the orifice of the ducts or the urethra, when it communicates, may be employed, and both antero-posterior and lateral views taken, the same principle being employed as with a sinus or fistulous tract. The treatment consists of cauterization of the duct and its complete obliteration whenever possible.

Davis H. Pardoll, M.D.

Intravenous Urography by Means of the Sodium Salt of 5-Iodo-2-Pyridon-N-Acetic Acid. Moses Swick. Jour. Am. Med. Assn., Nov. 8, 1930, XCV, 1403.

A comprehensive review of the experi-

mental work preceding this preparation is interesting. This work was begun with N-methyl-5-iodo-2-pyridon, synthesized by Professors Binz and Räth. The study of its excretion through the kidney and into the bile, and its iodine content (54 per cent) led to the thought that the substance might be applicable for roentgenologic purposes. Simultaneous studies of its excretion, limited to determination of the iodine component, revealed about 75 or 80 per cent of the injected iodine in the urine in from twelve to sixteen hours.

The experience with this substance brought out the need for a modification, possessing better tolerance and greater solubility, so that a larger dose could be administered. When a preparation having a lower iodine content, and the sodium acetate group substituted for the methyl, was furnished by Professor Binz, the clinically applicable and successful substance, 5-iodo-2-pyridon-N-acetate of sodium, was finally obtained. The sodium salt (42.2 per cent iodine) is non-toxic, very soluble in water, and neutral in its reaction. The tolerance for this compound is exceedingly great. The blood urea, phenolsulphonephthalein, the indigo carmine, and the dilution and concentration tests are of great assistance in establishing the contra-indication to the application of this method in a given case of bilateral advanced kidney disease. Where the blood urea is high, and the concentrating power of the kidney poor, the method yields few anatomic data and becomes not only superfluous but perhaps is attended with danger. The administration and dosage are given in detail. The reactions, contra-indications, and application of the method are interestingly discussed.

CHARLES G. SUTHERLAND, M.D.

Roentgenologic Diagnosis in Tuberculosis of the Kidney. B. H. Nichols. Texas St. Jour. Med., August, 1930, XXVI, 283.

This paper omits the clinical, urinary, and cystoscopic findings in kidney tuberculosis. It discusses the types of tuberculosis, their pathology, and the use of pyelography. The author summarizes as follows:

1. In every suspected case of renal tuberculosis, stereoscopic films should be made, showing the size, shape, and position of both kidneys.

2. Irregular calcifications of varying density are characteristic of renal tuberculosis in the process of repair, as are also calcific deposits in the walls of the ureters.

3. A pyelogram can be made of the suspected kidney without hesitation, even though tubercle bacilli are found in the urine.

4. When a diagnosis is made of tuberculosis in one kidney, it is necessary, in order to decide upon the advisability of operation, to determine the condition of the other kidney.

5. A pyelogram of the unaffected kidney can be made by the intravenous route, without risk of infection, and both kidneys may thus be shown at the same examination.

6. The presence of a localized destructive lesion near or at the base of a papilla, with the pelvis and other calices normal, is an indication of early renal tuberculosis, particularly if the affected area has irregular, serrated edges.

7. Multiple strictures of the ureter, in combination with pyonephrosis which has apparently involved only portions of the kidney, are highly suggestive of tuberculosis.

8. In advanced cases there may be marked pyonephrosis with areas not unlike an ostrich plume. These are characteristic.

9. The pyonephrosis may be complicated by hydronephrosis, particularly in cases in which there is stricture of the ureter.

10. A perinephritic abscess, with a fistula into the intestine, is apparently always tuberculous.

11. The final diagnosis of renal tuberculosis must always be confirmed by the finding of tubercle bacilli in the urine, or by a characteristic history and confirmatory cystoscopic findings.

12. The appearance in the roentgenogram of a more or less characteristic pathologic picture, together with the presence of tubercle bacilli in the urine from the catheterized kidney, will almost always confirm the diagnosis of renal tuberculosis.

13. The best results are secured when the roentgenologic examination is evaluated by a

competent roentgenologist, and the history, physical examination, and cystoscopic findings are interpreted by a capable urologist.

W. W. WATKINS, M.D.

Uroselectan: Reactions Accompanying its Practical Application: Report of Cases. George W. Hartman. California and Western Med., December, 1930, XXXIII, 867.

The author reports a number of cases in which he has used uroselectan intravenously as an opaque medium for outlining the urinary tract. All his patients complained of pain at the site of the injection (in mid-arm or shoulder); however, one patient, in which the gravity method was used, did not complain of as much pain.

Among his conclusions, the author finds that this method is valuable in patients in whom there is an obstruction at any point that would prevent the passage of an instrument, and would also include stricture, double ureter, prostatic hypertrophy, bladder diseases, hemorrhage, ruptured kidneys, infection, fistula; and in children. In two cases reported there was a marked anaphylactic reaction. He suggests that caution be used in thyrotoxicosis, pregnancy, active tuberculosis, acute or chronic renal disease, and circulatory disturbances. Uroselectan will not find a dead kidney. There is no danger of over- or underdistention.

FRANCIS B. SHELDON, M.D.

Anomalous Renal Rotation and Associated Anomalies. William F. Braasch. Jour. Urology, January, 1931, XXV, 9.

The author presents a very interesting and comprehensive paper on this subject. Fusion, ectopia, rotation alone, and torsion of the kidney; also, embryonic pelves are considered. Anomalous rotation is apparently an important etiologic factor in the pathologic complications which frequently occur with renal anomaly. This condition is most frequently observed with renal fusion and congenital dystopia, although it may occur without any other evidence of renal anomaly. It may be the cause of urinary stasis and pyelectasis, with resulting renal pain, and may be regarded as a distinct clinical lesion. When rotation of the kidney occurs, secondary to acquired factors, the term "renal torsion" is employed to distinguish it from anomalous rotation. The absence of other evidence of embryonic deformity aids in the recognition of this condition clinically. The so-called embryonic or congenital pelvis is characterized by a sacculated, elongated pelvis, with multiple abbreviated calices extending laterally, and an elongated, cephalic calix. Pain in the kidney of obscure etiology frequently is observed with anomalous rotation, although surgical exploration may disclose little evidence of gross pathologic change other than anomaly.

The treatment consists in the removal of all obstruction to urinary flow. Aberrant vessels or surrounding tissues producing tension on the pedicle or ureter, either permanently or temporarily, are removed. Occasionally resort must be had to nephropexy, plastic repair, or nephrectomy. Hydronephrosis or calculi are the most frequent complications and, if present, require the necessary procedure.

DAVIS H. PARDOLL, M.D.

Intravenous Urography with Uroselectan. John Duff. U. S. Naval Med. Bull., October, 1930, XXVIII, 715.

The introduction of uroselectan for intravenous urography is the most important accomplishment of this decade in urology. Uroselectan contains 42 per cent of organically combined iodine, and the formula is that of a sodium salt — 2-oxy-5-iodopyridin-N-acetic acid. It is freely soluble in water and when injected intravenously is excreted by a functioning kidney in sufficient concentration to give contrast on an X-ray film. The method is particularly valuable when there is partial or complete obstruction of the ureter due to stone, stricture, or tumor, because under these conditions the shadow is quite dense on account of the mechanical retention and concentration of the substance.

At the James Buchanan Brady Foundation of Urology of the New York Hospital no se-

rious reactions have been observed. At the New York Hospital the first film is made in five minutes, the second in fifteen minutes, the third in half an hour, the fourth in one hour, the fifth in two hours, and the sixth in three hours. Von Lichtenberg recommends that the first film be taken in fifteen minutes, the second in forty-five minutes, and the third in one one-half hours. On an average the best film is obtained thirty minutes after injection.

W. W. Watkins, M.D.

Diagnosis and Treatment of Tuberculosis of the Genital Tract. J. Dellinger Barney, J. Laxton Watson, and Simeon Elliott. Am. Jour. Surg., October, 1930, X, 84.

It is conceded by all that genital tuberculosis is but another local manifestation of a primary focus elsewhere in the body, this focus being generally in the lungs or bronchial glands. Whether or not urinary or genital lesions precede one another cannot be ascertained; however, they are not infrequently associated with one another. Hence, it is inadvisable to remove the entire seminal tract in cases of genital tuberculosis, if renal complications are suspected or likely to be present.

It is a fact that in juvenile patients the prostate and epididymis are less frequently attacked by tuberculosis than in the adult, due, no doubt, to the lack both of function and physical development at this time of life. There is some doubt in the authors' minds, based upon both autopsy material and hospital patients, regarding the priority of the prostate in genital tuberculosis. The diagnosis of tuberculosis of the epididymis usually yields the characteristic diagnostic features of induration, enlargement, nodularity involving especially the lower pole, and, but insignificant, pain or tenderness. The vas may be thickened and beaded. Most important is the presence of a healed or active sinus. Hydrocele may mask the scrotal pathology, and rarely tubercle bacilli may be demonstrated in the aspirated fluid. Other conditions must be differentiated. Rectal examination will usually reveal the accompanying changes in the vesicles and prostatic lobe on the side affected, but these may be absent.

The treatment depends almost entirely on what the surgeon believes to be the primary focus of the disease. If the prostate and seminal vesicles are thought to be the point of origin, radical and extensive surgery, with the entire removal of the genital tract, will be advocated. The opinion regarding such a radical procedure, however, varies, some advocating no surgery at all. The authors have had gratifying success with conservative surgery. A modified technic is employed in performing an epididymectomy on the side affected, with ligation and partial excision of the vas on the opposite side, even though it were free from disease at the time of operation; thereby the usual involvement at a later date by tuberculosis of the side not operated upon is prevented, although if present but unrecognized at the time, it will also require removal. This procedure has been followed by comfort and the retrogression of pathological processes in the prostate and seminal vesicles to the point of clinical cure. In addition, hygienic and supportive measures, commonly employed in the treatment of phthisical conditions, are to be rigidly adhered to, together with heliotherapy and tuberculin post-operatively.

Davis H. Pardoll, M.D.

Uroselectan Urography. Milton Weinberg. Southern Med. and Surg., December, 1930, XCII, 874.

Uroselectan for intravenous urography is in its infancy, but there is enough evidence to show that it will be a valuable aid in urological work. The technic is described. Sufficient information may be secured in the first roentgenogram taken ten minutes after the injection to obviate the necessity for further films. On the other hand, in poorly functioning kidneys, twenty-four hours may elapse before a shadow appears. The chief advantages are: (1) Ease of administration; (2) avoidance of discomforts of the cystoscope; (3) a more natural appearance of structures, if good roentgenograms are obtained; (4) use in patients who cannot tolerate cystoscopy; (5) use in pa-

tients who, because of some anatomical abnormality, cannot be examined by the cystoscope; (6) use in cases in which ureteral orifices cannot be found; (7) use in cases in which inflammation contra-indicates cystoscopy; (8) use in children. Obviously the method fails to outline the urinary tract below an obstructing lesion, and, in this and many other cases, it must be supplemented by cystoscopy.

W. W. WATKINS, M.D.

GENITO-URINARY TRACT (THERAPY)

Present Status of Electrosurgery and Diathermy in the Treatment of Diseases of the Genito-urinary Tract. Abraham G. Fleischman. Am. Jour. Surg., October, 1930, X, 116.

The author cites his experience with diathermy in various genito-urinary conditions over a period of seven years. The technic employed is given, together with illustrations. In order to obtain successful results with this form of therapeutic aid, one must be accurate in the diagnosis of the condition to be treated, possess the proper high frequency machine, with suitable electrodes, and have an exact understanding of the basic principles of high frequency currents.

DAVIS H. PARDOLL, M.D.

Consideration of the Surgical Procedures in the Treatment of Malignant Disease of the Urinary Bladder. Verne C. Hunt. Am. Jour. Surg., October, 1930, X, 69.

The author confines himself to the consideration of the more or less extensive lesions of the bladder which fail to respond to transurethral treatment and demand surgical procedures. In the truly inoperable lesions the greatest prospects of cure and of palliation may be expected from the combined use of surgery and physical agents. Of 480 graded epitheliomas of the bladder, 58 per cent were malignant, graded 3 or 4 (Broders' index). Lesions of the base of the bladder are more malignant than those of the dome or lateral wall. Experience shows that some of the physical agents are more effective in the treatment of the highly malignant cases, because of their greater radiosensitivity. The lesions of lower grade of malignancy are less apt to infiltrate and extend extravesically and, therefore, warrant more extensive surgical procedures, with reasonable assurance of a cure. The author is emphatic in his preference for surgery in operable malignancy of the bladder, and the results thereof are most successful. However, surgery is seldom justified when the percentage of risk is relatively higher than that of the prospect of cure.

Tumors of the lateral and posterior walls and dome of the bladder are best excised by cautery. When infiltration is present, resection may be done, including immobilization of the bladder where necessary. Tumors of the base require consideration of the ureters. Occasionally the ureters are not encroached upon and resection is possible without either resection and ligation or resection and re-implantation into the bladder. The mortality rate was found to be lower in the former.

In cases in which cystectomy is indicated, the ureters should be transplanted into the sigmoid (C. H. Mayo and Coffey methods), one at a time, preliminary to cystectomy, thereby establishing good renal function and satisfactory urinary control, with the ureters in the sigmoid. Cystectomy may then be performed several weeks later, entirely confined as an extra-peritoneal operation.

DAVIS H. PARDOLL, M.D.

GRENZ RAYS

The Effect of Grenz Rays upon the Skin: Histological Investigations. Karl Herxheimer and Erich Uhlmann. Arch. f. Dermat. u. Syphilis, May, 1929, CLVII, 467.

Biological and clinical investigations have shown that Bucky's Grenz rays produce specific effects, as compared with other types of radiation, especially roentgen rays. The authors made a histological examination of radiated skin and found that the Grenz rays penetrate into the skin to a very limited degree. For small doses, which correspond to about one-half of an erythema dose, the influence of radiation upon the epithelium consists in an extensive loosening up of the tis-

sue, in a vacuolization of the cell nuclei, casually in a complete absence of the net structure of the protoplasm, a complete acanthosis and often in a hyperkeratosis and a parakeratosis. Changes in the cutis, however, could not be observed. These effects, which were observed from a histological examination, closely resemble those produced on the skin by ultra-violet radiations. If, however, Grenz-ray doses, which are larger than the erythema dose, are applied, the effects, observed macroscopically, are identical with those produced by overdosage with roentgen rays. Microscopic examination revealed changes in the stratum granulosum and stratum spinosum, together with definite alterations in the basal cell layer and the corium, these alterations being especially manifested in the damage to the endothelium and the adventitious cells of the vessels. The distinction between Bucky's Grenz rays and other types of radiation is therefore justified.

O. GLASSER, Ph.D.

The Absorption of Grenz Rays in Air. Heinz-Theodor Meyer. Strahlentherapie. 1930, XXXVIII, 778.

The absorption of Grenz rays in air and the resulting changes in penetration of the remaining beam were studied by the author for potentials from 6 to 12 K.V., by means of an integrating dosimeter. The ionization chamber was independent of the wave length in the region examined. Aluminum filters of from 0.01 mm. to 0.055 mm. thickness were used as absorbers. The results are shown in a number of graphs. It appears that the narrowing of the beam, due to an increase in the focal distance, is more pronounced at higher potentials. For low potentials, the change in the penetration due to air absorption is so small that it is negligible for practical purposes. Since the quality of radiation is greatly dependent upon the thickness of the Lindemann window, the relations between tube potential and penetration of the beam should be determined for each tube by measurements of the half value layer in either aluminum or cellophan. The same holds for the dose curves at different focal distances. Due to the increased absorption in the window, with increasing age of the tube, such measurements should be carried out at least every 100 hours of usage.

ERNST A. POHLE, M.D., Ph.D.

GYNECOLOGY AND OBSTETRICS

Roentgen Examination of the Female Urethra, Specially in Cases of Prolapse and Incontinence. Einar Thomsen. Acta Radiologica, 1930, XI, Fasc. 5, No. 63, p. 527.

The author describes the technic used in visualizing the female urethral tract on roentgenograms. Two methods are used: one consists of applying a barium paste to the urethral walls, and the other of injecting lipiodol while an exposure is made. He illustrates and describes the changes in the course of the urethra, with structural weaknesses in the pelvic floor.

M. J. GEYMAN, M.D.

Low Voltage X-ray for a Therapeutic Menopause. J. Craig Potter. New York St. Jour. Med., Aug. 1, 1930, XXX, 915.

This author calls attention to the fact that the artificial menopause was produced in thousands of cases before the advent of high voltage machines, and that Hanks is still using low voltage for this purpose. Her technic is a kilovoltage of 100, 5 ma., 10-inch distance, 25 mm. copper filter, cross-firing through four areas, for an average of nine minutes to each area. Treatment is given each month after menstruation, half the treatment being given one day, and the other half two days later. An average of three treatments was required to produce a menopause.

W. W. WATKINS, M.D.

Menstrual Headaches. Charles L. Martin. Am. Jour. Roentgenol. and Rad. Ther., September, 1930, XXIV, 267.

In reviewing the histories of gynecological cases sent in for radiation therapy, the author has found that severe recurrent headache, associated with menstruation, has appeared many times as one of the major symptoms

bringing the patient to a physician. One combination of symptoms, consisting of menstrual headache characterized by pains in the occipital or frontal regions, nausea and vomiting, relieved during pregnancy, has occurred frequently enough to indicate the possibility of a specific underlying causative factor. He holds that this type probably has an endocrine origin, and may be partially or completely relieved in a certain number of women past the age of forty by the production with irradiation of an artificial menopause, but that the use of castration in younger women seems of doubtful value and may even accentuate the symptoms. The literature on the subject is reviewed and six cases cited.

J. E. Habbe, M.D.

The Sterilization of Women by Roentgen Rays. G. Fritschi. Strahlentherapie, 1930, XXXVIII, 739.

The author describes the development of the technic for roentgen sterilization in his clinic. At present two tubes are used simultaneously; the anterior and posterior fields are 17×17 sq. cm., and the surface dose amounts to 492 r per area (170 K.V., 30 cm. F.S.D., 1.2 mm. Cu + 1.0 mm. Al, H.V.L. in Cu = 1.5 mm.). This corresponds to approximately 417 r in 10 cm. depth. Only in very rare cases, the patients treated with this technic developed a faint erythema.

Ernst A. Pohle, M.D., Ph.D.

The Roentgen Ray as an Adjunct in Obstetric Diagnosis. Harvey B. Matthews. Am. Jour. Obst. and Gynec., November, 1930, XX, 612.

The author calls attention to the fact that radiography is insufficiently employed in obstetric and gynecologic diagnosis. He enumerates the conditions in which the X-ray is a valuable adjunct in obstetrical diagnosis, as follows:

Those relating to the maternal pelvis: (1) deformities; (2) pelvimetry; (3) bony or calcified pelvic tumors; (4) separation of the pubic symphysis; (5) amount of healing after pubiotomy.

Those relating to extra-uterine pregnancy: (1) tubal pregnancy; (2) abdominal pregnancy.

Those relating to intra-uterine pregnancy: (1) diagnosis of pregnancy before other characteristic signs and symptoms appear; (2) diagnosis of pregnancy as early as the fourteenth week; (3) multiple pregnancy; (4) presentation and position of fetus; (5) cephalometry; (6) death of fetus; (7) monsters, anencephalus, hydrochephalus, etc.; (8) spina bifida and other skeletal defects; (9) syphilis of fetal bones; (10) hydatidiform mole (by exclusion); (11) intra-uterine fractures; (12) osteogenesis imperfecta; (13) illegitimate pregnancies in which no examination can be made; (14) diagnosis of pregnancy, presentation, and position in very large fat women, 200 to 300 pounds; (15) routine examination should be made before cesarean section to determine if the child is normally formed.

Those relating to pelvic tumors simulating pregnancy: (1) fibroid tumors; (2) myomas and pregnancy; (3) ovarian cysts, particularly dermoids.

Miscellaneous conditions: (1) spontaneous version; (2) pseudocyesis; (3) mechanism of labor; (4) mode and method of separation of placenta (Warnekros); (5) lithopedion; (6) location of placenta (amniography, method of Menees, Miller, and Holly); (7) proof of extra-uterine life (Vogt).

With regard to dangers to the fetus, the author, an obstetrician, says: "We feel sure that no pregnancy, regardless of its stage of development, is damaged by diagnostic roentgenology properly carried out."

Jacob H. Vastine, M.D.

Radium in Gynecology. Sidney Forsdike. British Med. Jour., Sept. 20, 1930, No. 3637, p. 468.

The author in this article, by demonstrating the startling differences in technic in vogue at present in radium therapy, is trying to stimulate research in this field, in order that our present knowledge, which is still in its infancy, may be multiplied and some uniform therapy arrived at. He sketches a brief outline of the history of radium in medicine:

how the enthusiasm and unsubstantiated claims of thirty years ago were followed by a period of complete disillusionment in five or six years when radium treatment was left to the few who still had faith; how we are now in the second advent, and the enthusiasm displayed suggests that history is repeating itself. At the present time responsible men are making themselves answerable for statements that from 70 to 80 per cent of early cancers are curable by radium; such claims may possibly be prophecy—they are not history. There is a glut of hastily written books on treatment by radium, and a still greater stream of reports of cases treated within the year. As a result of this present-day enthusiasm sired by our profession and nourished by the press, enormous sums of money have been utilized to purchase quantities of radium for clinical work, without one milligram being allocated for biological research. One would suppose that there was nothing unlearned of the effects of radium upon living tissues, and that, given the supply, the disappearance of the cancer was only a matter of application. A certain amount of work has been done upon normal tissues, tissue cultures, and animal tumors. The knowledge gleaned from these sources is of great value, but it must be multiplied a hundredfold before we are in a position to direct the gamma ray with precision and certainty.

The following problems are discussed: *(a)* whether radium acts directly upon the cell or upon the stroma, and the importance of this question as affecting the dose to be employed; *(b)* the value of metal screens, and the wide divergence of opinion among such authorities as Cade, Larkin, and Simpson for the absorption of 99.9 per cent beta rays; *(c)* the problem of split doses—whether the dose should be applied continuously or divided into two or more exposures. Lazarus-Barlow's experiments on the question of a large dose acting for a short time, having the reverse effect from a relatively small dose acting for a longer time on squamous and columnar epithelium, are discussed; *(d)* the various methods in use in the treatment of regional glands are so divergent that the urgent need of organized research in this direction is obvious; *(e)* in the production of artificial menopause, there is a difference of opinion not only as to dosage but as to whether it is the endometrium or the ovary that is affected.

With regard to fibroids, the only exception to the rule of excision is in cases in which hemorrhage is the cardinal symptom. In the treatment of cancer of the cervix it is slowly being recognized that the early results are not permanent in the majority of cases, and, therefore, not worth recording except as evidence of the value of radium for palliative treatment.

The author, while remaining a believer in radium, is convinced that to-day surgical treatment offers the patient a better chance of cure.

W. D. MACKENZIE, M.D.

The Present Value of Irradiation Therapy in Gynecology. Fritz Heimann. Med. Klinik, Oct. 17, 1930, XXVI, 1545.

The value of irradiation therapy in gynecologic diseases is considerable; it is one of the most important therapeutic means in this field. Many hundreds of myomas have been treated by irradiation in the author's clinic. The amenorrhea could be induced in almost all cases; only twice, a malignant degeneration was observed and only a few times a renewed growth of the myoma after some years. Surgical removal is practised in questionable cases and in very large tumors. In about 7 per cent of the patients, uterine bleeding was noticed again, but was rarely excessive, most of it appearing as normal menses.

The results of irradiation therapy in myomas are excellent. The severity of climacteric symptoms, caused by irradiation or surgery, seems in either case the same. One must know that the menses may appear once or twice after the roentgen treatment. Excessive menstruation in young women should not be treated by means of irradiation; the danger to the germplasm is too great. Temporary castration is used only in tuberculosis or gonorrhea, as the chances for a later pregnancy are poor.

Roentgen treatment of the spleen in exces-

sive uterine bleeding has impressed the author favorably, and the method is simple. In these benign disorders only roentgen rays are used, as radium has certain technical disadvantages. In amenorrhea and sterility, caused by ovarian dysfunction, a small dose of roentgen rays appears to be of benefit in some cases. No damage is done if one is sure of the amount of irradiation. In climacteric symptoms a small dose of roentgen rays to the hypophysis and thyroid will often achieve good results, when all other therapeutic means have been exhausted. The author's standpoint in the treatment of uterine carcinomas is, that all operable cases should be operated on, that post-operative roentgen treatment is of great value, and that inoperable cases should be treated radiologically.

H. W. HEFKE, M.D.

Newer Methods of Roentgenographic Contrast Diagnosis in Obstetrics and Gynecology. Julius Jarcho. Med. Jour. and Rec., Oct. 15, 1930, CXXXII, 395.

The author has been using the combination of pneumoperitoneum followed by oil and has designed an apparatus for this purpose. For the pneumoperitoneum, from 800 to 1,500 c.c. of oxygen or carbon dioxide are first injected by the transuterine route if the tubes are patent, otherwise by the abdominal route. The oil is injected through the cervical canal. After 3 c.c. is injected the first roentgenogram is made; then additional films after 5, 8, 10, or even 15 c.c. of oil. Either method may be used alone, or a combination, when one method will not give the desired information. In this way the clinician may map out the pelvic viscera, or outline the inside and outside of the uterus. The same procedure often shows the tubes and normal ovaries, while neoplasms of the uterus and adnexa are often plainly shown. The diagnosis is thus more precise, and often enables one to make an intelligent choice of method of treatment, whether surgery or radiation. Oftentimes when an operation would sacrifice the uterus and make child-bearing impossible, patients will choose irradiation. The procedure can be carried out by a gynecologist or by a radiologist, preferably by the two together. By using strict asepsis and gentleness of technic, complications will be avoided, and the co-operation of the patient secured.

W. W. WATKINS, M.D.

On the Therapy of Fibroids and Hemorrhagic Metropathy in the Women's Clinic at the University of Würzburg, 1923-28. Paul Uebel. Strahlentherapie, 1930, XXXVIII, 438.

This statistical paper does not lend itself well to abstracting. In view of the enormous material there, it is recommended for study in the original. Only a few of the principal points can be mentioned here. Sterilization by roentgen rays was carried out by applying one anterior and one posterior field. The dose effective in the ovaries amounted to 275 r. In many cases, it was not necessary to give as high a dose. Sometimes permanent amenorrhea was obtained following the application of about 180 r in the ovaries. Temporary amenorrhea required about 160 r. The equivalent radium doses were 3,000 mg.-hrs. for permanent amenorrhea, and about 1,500 mg.-hrs. for temporary amenorrhea. In cases in which there was suspicion of a sarcoma, from 4,000 to 5,000 mg.-hrs. were given intrauterine. This dose has been increased lately to 7,000 mg.-hrs. or 830 r with roentgen rays. If roentgen and radium rays are combined, about one-half of the full dose of either agent was used.

Only a few cases were operated on. The indications for operation were indefinite diagnosis, young age of the patient, pedunculation of the fibroid or incarceration, excessive size of the fibroid or degeneration. The entire material is subdivided into clinic patients and private patients. A total of 318 private patients were observed during the period from 1923 to 1928. Two hundred and three had a fibroid, and 115 had hemorrhagic metropathy. Of the fibroids, 17 were treated by curettage, 142 by irradiation, and 44 by operation. The respective figures in the group of hemorrhagic metropathy were 11,104, and none. A total

of 246 cases, namely, 142 of fibroid and 104 of hemorrhagic metropathy, were irradiated. In the fibroid group, 127 had permanent amenorrhea and 15 temporary amenorrhea. The respective figures for the hemorrhagic metropathy cases were 76 and 28. Of a total of 730 clinic cases, 384 had a fibroid and 336 hemorrhagic metropathy. Six hundred and forty-five were irradiated and 85 operated on. In the fibroid group, 330 were irradiated, 45 operated on, and 19 curetted. The respective figures for the hemorrhagic metropathy were 315, none, and 21. Of the 330 irradiated fibroids, 271 had permanent amenorrhea and 59 temporary amenorrhea. The respective figures for the hemorrhagic metropathy group were 261 and 54. The average hospitalization of private and clinic patients was nine days for radiation therapy and nineteen days for uncomplicated operation.

The author states, in conclusion, that radiation therapy of fibroids and hemorrhagic metropathy has not only given good results in their cases but should be used more in preference to operation.

ERNST A. POHLE, M.D., Ph.D.

HEART AND VASCULAR SYSTEM (DIAGNOSIS)

Far-reaching Effects of Gamma Rays and Short X-rays upon the Human Heart: Electrocardiographic Results of Cancer Treatments Given without Direct Irradiation of the Heart. J. E. Gendreau. Ann. Surg., January, 1931, XCIII, 476.

Cardiovascular disturbances produced by large doses of gamma rays and short X-rays, even when the heart itself has not been directly treated, are accompanied by symptoms of dyspnea, tachycardia, general fall of blood pressure, and asystolia in very serious cases. The author has used electrocardiograms before, during, and after treatments by radium and X-rays. Many records were taken in cancer cases in which the irradiation area was not directly over the heart. In each case the changes are appreciated by comparison with the tracings taken before treatments. The records show the action of the gamma rays and the X-rays upon the heart at a distance; by additional *P* waves, and impure flutter; by flattening of the *P* waves, and auricular fibrillation; by abnormal *Q R S* complexes, in general with lower voltages and reduction of the tracings to a line, occasionally with maximum voltages—very deep *Q* and *S* deflections; by deep inverted *T* waves, sharp and rounded, with occasional notchings in the ascending branch. *R T* is constant but *T P* is generally increased and the resulting rhythm slower immediately after a treatment. In premature ventricular contractions on the contrary, *T P* is greatly reduced and *P* immediately follows *T*. The extra systole is generally succeeded by the compensatory pause. Tachycardia is less common than bradycardia.

Electrocardiograms may be useful in the direction of a cancer treatment by irradiations.

F. B. MANDEVILLE, M.D.

The Effect of Amyl Nitrite on the Size of the Heart and the Width of the Aortic Shadow as Determined Roentgenologically. William A. Brams and Herman A. Strauss. Am. Jour. Med. Sci., November, 1930, CLXXX, 618.

In 21 patients the size of the cardiac and aortic shadows was studied roentgenologically before and after the administration of amyl nitrite, including 6 normal persons and 15 with arteriosclerosis. The transverse diameter of the heart was reduced in 18 patients, regardless of whether or not arteriosclerosis or hypertension was present. The width of the aortic shadow was increased in 13 patients. This result also seemed to be independent of the condition of the peripheral vessels or degree of blood pressure.

W. W. WATKINS, M.D.

The Size of the Heart in Goiter: A Teleroentgenographic Study. Lewis M. Hurxthal, O. J. Menard, and M. E. Bogan. Am. Jour. Med. Sci., December, 1930, CLXXX, 772.

The question of cardiac enlargement from hyperthyroidism has long been unsettled, and many statements have been made without adequate statistical data. A study has been made

of 100 patients with hyperthyroidism and a corresponding number of normal controls. Radiographs were made at a seven-foot distance, and studies made on the basis of age, sex, type of goiter, presence of accompanying heart disease, etc. No definite relationship was found between the duration of the disease or loss of weight and size of heart; cardiac enlargement showed a fairly direct relationship to age and coincident cardiovascular disease; the number of enlarged hearts was practically the same in both toxic and nontoxic goiters; if hyperthyroidism causes enlargement or hypertrophy and dilatation, it is slight.

W. W. WATKINS, M.D.

HODGKIN'S DISEASE (DIAGNOSIS)

An Analysis of the Lymphadenopathy Question, with Special Reference to Hodgkin's Disease and Tuberculosis. Fred W. Stewart and Charles A. Doan. Ann. Surg., January, 1931, XCIII, 141.

The authors quote: "Our knowledge of Hodgkin's disease has been clarified or rendered more obscure—depending on the point of view—since Sternberg demonstrated the close association of the disease with tuberculosis, and from that time on the tubercle bacillus has never been satisfactorily dissociated from the Hodgkin's picture." Studies are cited which have tended more and more to favor the concept that Hodgkin's disease is a special manifestation of tuberculosis. Recent studies disclose that animals showing a high physiological level of monocytes in contrast to lymphocytes are relatively more susceptible to acute, progressive tuberculosis than those having a low M/L index. The epithelioid cell of the tubercle has its origin from the monocyte, and epithelioid cells as identified in the supravital technic have been found as a part of the cellular reaction in Hodgkin's nodes. The newer bacteriologic studies of Petroff in the dissociation of various pure strains of avian, bovine, and human tubercle bacilli are important. The correlated chemical and biologic studies of the whole group of acid-fast bacilli, under the direction of the Research Committee of the National Tuberculosis Association, are aiding in interpreting the mechanism underlying the varying pathology characteristic of tuberculosis.

The authors discuss especially the chemical partitions thus far studied, and the phosphatid fraction from the lipoids, as isolated by Dr. R. J. Anderson of Yale University. Comparable phosphatid fractions from human, bovine, and avian tubercle bacilli have been isolated. In a study of 350 clinical cases during the past two years, of which the majority were tuberculous, frequent ability to precipitate the tuberculo-phosphatid in high titer, or the precipitation with a phosphatid antiserum of suspected uncombined antigen, has been demonstrated. Twenty-six of thirty-two cases of Hodgkin's disease showed a capacity of the blood serum to precipitate the phosphatid in a dilution of 1–640 (of an original 1 per cent suspension) or higher. This is well within the range of positive reactions observed in known tuberculous cases. An ultimate understanding of both the pathological agent or factor and the mechanism of adjustment or resistance must precede any final approach toward the control of each definite etiological entity in disease.

F. B. MANDEVILLE, M.D.

The Genetic Neoplastic Relationships of Hodgkin's Disease, Aleukemic and Leukemic Lymphoblastoma, and Mycosis Fungoides. Aldred S. Warthin. Ann. Surg., January, 1931, XCIII, 153.

In 100,000 diagnostic tissue examinations made in the Pathological Laboratory of the University of Michigan between the years 1895 and 1927, there were 506 cases, approximately 0.5+ per cent, of all cases diagnosed as Hodgkin's disease, aleukemic and leukemic lymphoblastoma, and mycosis fungoides. During the same period, in 2,000 autopsies, there were 83 cases falling into the same diagnostic categories.

An analysis of the above material forms the foundation upon which the following conclusions are drawn:

1. Hodgkin's disease, sarcomatous Hodgkin's, aleukemic and leukemic lymphoblasto-

ma, aleukemic and leukemic mycosis fungoides are all true neoplasms and are genetically closely related.

2. Transition forms between all of the types exist.

3. They differ chiefly in the degree of differentiation shown by their cell types, and in their point of origin.

4. They all take their origin from perivascular reticulo-endothelium, or the maternal lymphoblasts of the lymphoid tissues of the body.

5. Those arising from the hematopoietic perivascular reticulo-endothelium take on the type of Hodgkin's, sarcomatous Hodgkin's (reticulocyto-endothelioblastoma), or even of myeloid forms of sarcoma. Those arising from the maternal lymphoblasts have the character of the lymphoblastoma, small-celled or large-celled, aleukemic or leukemic. The maternal lymphoblasts are derived from the same perivascular reticulo-endothelium, but represent a higher stage of differentiation than do the Hodgkin's and the reticulocyto-endothelioblastoma forms. The sarcomatous Hodgkin's of the reticulocytoblastoma type represents a greater differentiation than the Hodgkin's type, while the lymphoblastoma represents a higher stage of differentiation.

6. The more undifferentiated forms, Hodgkin's, sarcomatous Hodgkin's, and typical lymphoblastoma, occur chiefly in individuals of younger ages, while the typical aleukemic and leukemic neoplasms are more frequent in older individuals.

7. They all run a similar clinical course, often with fever, characterized by remissions and recurrence of the tumors, with the development of a progressive tumor cachexia, anemia, emaciation, and prostration. No case has ever been cured; when removed surgically, the regenerated glands become similarly involved in the process. While suggesting analogies with chronic infectious processes, they differ from these in that no mild or cured cases occur, there is no evidence of any immune reaction on the part of the organism, and the process shows a steady malignant progression to the fatal termination.

8. Pathologically, the lesions are neoplastic in type rather than granulomatous; they show true infiltrations and metastases. In their cell types and architecture they follow definite patterns which cannot be explained on the basis of an inflammatory reaction.

9. There is but one method of treatment which will delay but will not halt the inevitable malignant progress of these growths, and that is the judicious and systematic employment of X-ray irradiation.

F. B. Mandeville, M.D.

Bone Changes in Hodgkin's Disease. Kurt Kremser. Röntgenpraxis, Nov. 1, 1930, II, 998.

Lymphogranulomatous involvement of the medulla of bones has been described rather frequently. Changes in the compacta and spongiosa are not so frequent. In fifty-one cases this occurrence was found only twice. The changes in the roentgenogram are destructive in character, proliferative changes not having been observed. The vertebræ seem to be attacked more often than other bones, and only in the later stages of the disease does bone involvement seem to take place, which cannot be differentiated from other metastases in the roentgenogram. It was interesting that, contrary to other metastases, roentgen therapy did not seem to have any effect on the lesions.

H. W. Hefke, M.D.

JAUNDICE

The Clinical Significance of Jaundice. M. A. Blankenhorn. Jour. Am. Med. Assn., Oct. 11, 1930, XCV, 1066.

Although the physiologist and the pathologist have in recent times thrown great light on the problem of the formation of bile pigment and on certain functions of the liver, little has developed to help the surgeon with his question about stoppage of the ducts. The first and most important significance of jaundice is the possibility of stoppage of the ducts. To make a diagnosis of obstructive jaundice, one of three common procedures is generally followed: (1) If there is a history of colic, one argues from cause to effect, and says that

the stone that causes colic obstructs the duct; (2) tests for liver disease or tests of liver function can be done to exclude obstruction of the duct; (3) the symptom of jaundice can be studied to see whether obstruction of the ducts alone could give such a distribution of bile pigment.

Schiff reported no exception among 327 normal persons and patients that the van den Bergh direct reaction occurs with jaundice and bilirubinuria, and that the indirect reaction occurs with jaundice with no bilirubinuria, regardless of the pathogenesis of the jaundice. The study of the distribution of bile pigment to see whether stoppage of the ducts alone could explain the jaundice requires relatively simple laboratory methods.

The icteric index and the examination of duodenal contents and of the feces are simple and of good repute when properly interpreted. Cholecystograms by the Graham method unfortunately cannot be used when jaundice has fully developed. No other dye tests can apparently be used when jaundice is present.

CHARLES G. SUTHERLAND, M.D.

Physiologic Disturbances Incident to Obstructive Jaundice: A Review. A. C. Ivy. Jour. Am. Med. Assn., Oct. 11, 1930, XCV, 1068.

The physiologic disturbances incident to obstructive jaundice are too numerous to list and to discuss even briefly in a short review. Bile retained in the biliary passages not only may pass into the blood and thus influence many organs, but also may disturb the functions of the liver and the gastro-intestinal tract. Even if bile were not toxic in itself, one would expect disturbances due *(a)* to the effect of excessive biliary pressure in liver function; *(b)* to reflexes excited by excessive biliary pressure; *(c)* to the absence of bile in the intestine, and *(d)* to the effects secondary to these changes.

The toxicity of bile is discussed, also the liver damage, lack of bile in the intestine, and terminal nephritis. The patient suffering from prolonged jaundice presents a picture that results from the failure of a number of physiologic mechanisms. It is not known which one is primarily concerned. The fundamental nature of the reactions involved in producing the physiologic disturbances is not completely understood at present. The literature indicates that a carbohydrate diet, with milk and cod liver oil and calcium administration, is a worth-while therapeutic procedure in this condition.

The problem is being actively attacked by several groups of investigators, and the future of the understanding of physiologic disturbances in jaundice augurs well.

CHARLES G. SUTHERLAND, M.D.

MEASUREMENT OF RADIATION

Concerning a Source of Error in Calibrating a Müller Low Voltage Tube. Lothar Böhmer. Strahlentherapie, 1930, XXXVIII, 353.

Ionization measurements on low voltage X-ray tubes by interposing diaphragms of different diameters (5, 10, 15, and 20 mm.) revealed the fact that the strength of the beam without a diaphragm was 34 per cent higher than with the largest diaphragm. This may lead to errors in dosage if the calibration has been carried out with a diaphragm while the patient is treated without using one.

ERNST A. POHLE, M.D., Ph.D.

Measurements of the Half Value Layer in Aluminum. Heinz-Theodor Meyer. Strahlentherapie, 1930, XXXVIII, 329.

The absorption curves for roentgen rays produced at potentials between 30 K.V. and 190 K.V. at 10 K.V., steps were measured in aluminum by means of a large and a pressure ionization chamber. A therapy tube connected to a constant potential apparatus was used. From the absorption curves, the normal and reduced half value layer were obtained. The latter is procured by substituting the radiation used at any given point by its equivalent homogeneous radiation. Curves were then plotted, expressing the quotient obtained by dividing the normal and reduced half value layers. They show a striking irregularity between 90 K.V. and 110 K.V., which is in all

probability due to the influence of the K radiation of the tungsten anticathode.

ERNST A. POHLE, M.D., Ph.D.

Meteorological-medical Radiation Measurements in Defined Regions of the Spectrum. K. Büttner. Strahlentherapie, 1931, XXXIX, 358.

Based on investigations of Dorno, the author constructed an apparatus consisting of photo-electric cells, actinometer, and filter, which permits measurements in various parts of the spectrum of importance to the meteorologist and physiologist. A number of measuring results in the spectrum of the sun are reported.

ERNST A. POHLE, M.D., Ph.D.

RADIATION SICKNESS

The Relation between Cholesterol Metabolism and Roentgen Sickness. Rudolf Hummel. Strahlentherapie, 1930, XXXVIII, 308.

The cholesterol content of the serum is usually lower in man following roentgen deep therapy. In a few cases, the cholesterol is increased about three hours after the exposure. No relation between cholesterol drop in the serum and roentgen sickness could be observed, while the cholesterol drop in the total blood and roentgen sickness seemed to run parallel. The prophylaxis and treatment of roentgen sickness with "Colsil tablets" containing cholesterol, as suggested by Burgheim, were successful only in about 25 per cent of all cases.

ERNST A. POHLE, M.D., Ph.D.

Immunological and Biochemical Researches on the Biological Action of X-radiation and Radium. Luigi Cappelli. La Radiologia Medica, August, 1930, XVII, 905.

The theory that roentgen sickness is due to the formation of foreign proteins in the body which would cause a defensive reaction in the organism has been the object of study on the part of the author. He has resorted to immunological methods to attain a greater sensitivity than that obtained with chemical investigation.

The serum of three rabbits which had been given slightly different quantities of X-radiation was tested with the serum obtained from another rabbit heavily irradiated (950 r).

The serum of the latter was taken some hours after treatment; that is, when the general effects of radiation are felt most. The ratios in X-ray dosages were approximately the same as the ratios of the quantities of the substances used in immunological tests. According to the author, the mildly irradiated animal would have supplied the antibody, while the other would have furnished the antigen. No flocculation was observed, however, and the author voices the belief that the cause of roentgen sickness must be found elsewhere.

L. MARINELLI.

RADIUM

Post-operative Parotiditis: Treatment without and with Radium. Fred W. Rankin and Bean M. Palmer. Ann. Surg., December, 1930, XCII, 1007.

In the last four years, there have been 78 cases of post-operative parotiditis at the Mayo Clinic. The condition occurs most frequently following operations on the gastro-intestinal tract, more especially the sigmoid and rectum. Of the 58 cases treated without radium, 23 died—a mortality of 39 per cent. Of the 20 cases treated with radium, four died—a mortality of 20 per cent. Three of the four cases died of causes definitely other than parotiditis, so that the corrected total for radium cases reads 5 per cent. In only two of the 20 cases was it necessary to substitute surgical drainage.

By using radium, particularly by immediate application, within from one to two hours following swelling, the incidence of suppuration and absorption is decreased noticeably, with resulting decrease in morbidity and mortality. The maximal dose consisted of four applications, eight hours in duration, at intervals of eight hours, and of four 50-mg. tubes of ra-

dium. Filtration was through 2 mm. of lead, 1 mm. of brass, and 0.5 mm. of silver; the distance was 2.5 cm., and a total of 6,605 mg.-hrs. was given. The minimal dose was two applications, eight hours in duration, at intervals of eight hours, and of two 50-mg. tubes of radium, with filtration as above, and a total dosage of 800 milligram-hours.

F. B. MANDEVILLE, M.D.

Gynecological Notes, with a Special Reference to the Use of Radium. Kenneth Wilson. Med. Jour. Australia, Dec. 13, 1930, II, 786.

This is a summary and descriptive review of the Heyman, Lacassagne, and Donaldson technic in the treatment of carcinoma of the cervix, with descriptions of the current Continental practice in the use of radium in other gynecologic conditions. Although a purely réchauffé dish compounded from existing literature and a visit to European clinics, the paper has value in presenting the prevailing radium practice in a general non-critical manner.

J. G. STEPHENS, M.B. (Syd.), D.M.R.E.

Cosmetic Results of Electrocoagulation and Radium Treatment, Especially of Carcinoma of the Skin. A. Buschke and Ludwig Loewenstein. Med. Klinik, Oct. 24, 1930, XXVI, 1590.

Electrocoagulation is used only in combination with irradiation therapy in the authors' clinic. The first treatment and its correct administration is most important for the prognosis. Electrocoagulation should be preferred to surgery, as the danger of recurrences and implantation of metastases is much smaller. The tumor thus treated is covered with boric acid ointment for from eight to fourteen days, and radium treatment is instituted at that time. Fractional doses are used, and the lesion usually is healed in from three to eight weeks, depending upon its size. Local recurrences after this combination treatment are not frequent—much less, in fact, than after surgical excision. The cosmetic results are very satisfactory. Benign tumors, such as warts, pigmented moles, angiomas, and rhinophymas, have been treated by electrocoagulation with good results.

H. W. HEFKE, M.D.

Radium Treatment of Early Epithelioma of the Lip. Howard Hailey. Southern Med. Jour., December, 1930, XXIII, 1121.

The author states as follows: "I do not believe it is practical to outline a treatment for epithelioma of the lip which will be suitable for all cases." He then discusses the several methods advocated for malignant lesions on the lip, and states his belief, based on personal experience, that radium, properly used, will give a higher percentage of permanent cures of early squamous epithelioma of the lip than any other single method of treatment. His technic is to transfix the lip with several five-milligram needles of radium, just distal to the growth, leaving them in place for seven hours. Radium is also placed on the surface of the lesion.

(Abstractor's note: This author does not mention the treatment of the gland areas with X-ray, although he uses a half-strength plaque over the submental area, with 0.5 mm. brass filter, 10 to 12 hours. This appears to me to be a totally inadequate radiation for the lymphatic areas in treating cancer of the lip.)

W. W. WATKINS, M.D.

The Detection, Estimation, and Elimination of Radium in Living Persons Given Radium Chloride Internally (II). Howard H. Barker and Herman Schlundt. Am. Jour. Roentgenol. and Rad. Ther., October, 1930, XXIV, 418.

Elimination of radium chloride or other radium salt after introduction into the body by oral, intramuscular, or intravenous routes, has received particular investigation since the so-called "radium poisoning" cases gained public attention. Previous investigators computed elimination by collecting feces and urine, and estimating, quantitatively, the amount of radium excreted daily. From 25 to 35 per cent of that taken by mouth and from 55 to 65 per cent of that given intra-

venously is excreted within from four to five days of administration, but thereafter the rate of elimination in each instance is less than 1 per cent daily.

The present investigation was carried out on 10 patients ranging in age from 30 to 75 years, all of whom had taken radium amounting, in one instance, to as much as 1,130 micrograms of radium chloride, for a varied group of ailments, none of which had responded well to the usual therapeutic measures. The penetrating radiation within the body was tested for by a Wulf-Hess quartz fiber electroscope, while two new Lind ionization chambers, with an electroscope head, were used for detection and estimation of radium in the expired air of the patients, all radium values being expressed in terms of micrograms. Four of the 10 individuals were negative so far as radio-active tests were concerned, and the fifth case showed a mere trace. In three of the five remaining cases the patients had received material so recently that the finding of radio-active materials in their bodies caused no surprise. The two cases showing the largest amounts of radio-active material in their systems had had no radium administration for a period of two years, but each of these had had large amounts (one 890 and the other 1,130 micrograms) for intractable venereal disease.

J. E. Habbe, M.D.

Hairy Tongue Following Adjacent Radiation. M. T. Van Studdiford. Southern Med. Jour., December, 1930, XXIII, 1125.

Eight patients with carcinoma of the upper digestive tract (tonsil, tongue, mandible) developed hairy, or black tongue, within from two to five weeks following adjacent radium treatment. The whole lingual mucosa was involved in two cases, the condition persisting for eighteen months. Whether this was due to a symptom-complex inducing hyperplasia of the papillæ and pigmentation as the result of the organism found by Weidman (*Archives of Dermatology and Syphilology*, November, 1928, XVIII, 647), or to a stimulation by the irritant effect of radium, or to a lowering of the resistance of the mucosa, allowing invasion by organisms, has not been determined. The diseased area has a black-brown or yellow-brown fur-like appearance, made up of hairs measuring from ¼ to ½ inch in length.

W. W. Watkins, M.D.

The Present Status of Radium Surgery. H.-G. Zwerg. Strahlentherapie, 1930, XXXVIII, 487.

This is a review of the combined surgical and radium treatment of malignant tumors in the paranasal sinuses, larynx, esophagus, bladder, prostate, rectum, and stomach. Although Regaud does not believe in the value of radium surgery in uterine carcinoma, because of the high development of roentgen therapy, the author feels that the former is of benefit in the treatment of involved lymph glands and parametrium.

Ernst A. Pohle, M.D., Ph.D.

Radium and its Use in Uterine Diseases. W. E. Gary. Kentucky Med. Jour., September, 1930, XXVIII, 454.

There is no known method of determining which case will and which case will not respond to radium, without trial, any more than which will or will not be benefited by surgery or other means. Radium and X-rays give off the same rays, but radium can be placed where needed and the selected wave be had by proper screening. The uterus can stand more radiation than any other organ in the body, and radium is the accepted treatment in all cancers of the cervix. If competent surgeons and competent radiologists will co-operate, the future will be bright for increase in the number of cures in malignant disease, especially if the general practitioner will help by sending cases early.

W. W. Watkins, M.D.

Radium Therapy in Cancer of the Nose, Larynx, and Esophagus. H. M. Moran. Med. Jour. Australia, Dec. 20, 1930, II, 814.

Obstruction is frequently the primary symptom of tumors of the nasopharynx, by which time it is impossible accurately to gauge the

degree of bone or cartilage involvement. Interference with sinus drainage brings infection in its train. With bone invasion, osteomyelitis occurs; with cartilage invasion, necrosis occurs, and the sinister conspiracy of neoplasm, infection, and necrosis compasses the patient's destruction.

Cancer of the Maxilla.—In neoplasms of the superior maxilla the surgical act should be exploited to the utmost and the subsequent irradiation should be as complete as if no surgical treatment had been given. Cylindrical-celled carcinomas predominate; squamous-celled carcinomas may arise by invasion from without or by metaplasis of primary cylindrical-celled growths. Myxosarcomas and angiosarcomas are found. Osteogenic sarcoma is rare. Lymphosarcomas may occur and permit of dramatic, if ephemeral, success. Treatment is best commenced with deep X-radiation. Two weeks later operation follows, and this should expose the growth and, if possible, completely remove it, but even incomplete extirpation is valuable. The preliminary X-radiation prevents scattering of cancer cells, which might be caused by an incomplete operation. Partial removal, although not accelerating the growth according to Ledoux, may yet cause dangerous bleeding and delay the third stage of radium treatment. Radium is next applied either in radon seeds or in tubes. The former gives a fading dose, and adequate filtration cannot be obtained without rendering the seeds bulky. Filtration by 2 mm. of platinum and a secondary filter of Al and rubber is essential. Three tubes each of 10 mg. introduced for eight days for small areas (from 30 to 40 mc. destroyed), or otherwise from 10 to 12 tubes each of 3 mg. for four days (from 25 to 30 mc. destroyed), are employed. These three stages should be completed within one month, and the associated lymphatic glands must then be considered. Ledoux strongly advises irradiation of first relay of lymphatic glands. Close surveillance of these areas is imperative.

Cancer of the Nasopharynx.—Fibrosarcoma is more radiosensitive the younger the patient, and in adult growths of this kind surgery is indicated. Lymphosarcomata are best treated by X-radiation, and this type of growth is probably unique in the respect that irradiation of the primary focus has been known to cause the disappearance of distant metastases. The author commends the search for the cause of this phenomenon, which would reveal new horizons in radiotherapy.

Laryngeal Cancer.—In extrinsic growths the tumor is generally inaccessible and radioresistant, and gland involvement is early, so that palliation only, either by radium used at a distance of several centimeters, or by deep X-rays alone, is possible. The uniform and efficient irradiation of the whole area with radon seeds is usually impossible and the radium bomb has not improved the depressing results. Intrinsic cancer is more hopeful. This is essentially a cancer of the vocal cord, becomes subglottic by extension, but is not by nature highly invasive. It is relatively avascular, remains for a long time unilateral, and gland involvement is usually late. Moreover, an early alteration in voice quality acclaims the onset, and causes the patient to present himself at an early stage in the disease. Surgery gives good results in intrinsic cancer, and radium may give superior functional results, with a better voice quality. For effective radium treatment, the growth must be confined to the chord, and neither anterior commissure nor muscle nor cartilage be invaded. Voice quality is, of course, less important than final cure, and the choice between surgery and radium is as yet undecided.

The greater part of the lateral cartilage is resected, but it is essential that the perichondrium on the inner side should be left intact to shield the larynx from secondary inflammation. From 5 to 10 needles of one-half or one mg. of filtration, 0.5 mm. platinum, and length of from one to two centimeters, are placed vertically in the window thus made, and their tips tucked behind the cartilage, without perforation of the larynx. The threads of the needles are steeped in one in a thousand acriflavine solution. The wound is closed without drainage and the needles left in for from four and a half to eight days. Within ten days the tumor is reduced to a mere nodule, and usually disappears within six weeks. This technic, the only needle technic justifiable

in the larynx, is, of course, suitable only for growths of limited extent on account of the greater distance of the posterior needles from the growth. The author is emphatic in warning against the embedding of needles within the larynx. Glottis edema, following treatment, may necessitate low tracheotomy. Necrosis of cartilage, after deep X-radiation, at any rate, is an exaggerated danger unless the cartilage has become ossified, in which case the secondary rays may produce the condition. If the tumor has become subglottic a preliminary and very thorough distance radiation is advisable, after which the hemilaryngectomy is performed, and the same radium dose given as before. The vegetative or ulcerative type of growth arising in the ventricular cavity or band resembles the mucous membrane type of epithelioma, and is radiosensitive and suitable for deep X-ray treatment.

Cancer of the Esophagus.—The author doubts whether or not esophageal cancer is ever cured by our present methods. Inaccessibility, late appearance of symptoms, extensive longitudinal lymphatic spread, and early onset of infection account for the poor results. Fusion of enlarged posterior mediastinal glands may deflect the esophagus, as shown radiographically. The futility of introducing tubes of radium within the structure is thus manifest. Gastrostomy, to place the diseased area at rest, and to provide nutrition, should be the first step. Irrigation with a 2 per cent sodium bicarbonate may reduce the infection. The lesion is outlined accurately, either by radiography or by esophagoscopy. The treatment then proceeds, according to Guisez's or de Nabias' technic. The characteristic unpleasant salivation is usually not relieved, although the production of saliva can be controlled radiologically.

J. G. Stephens, M.B. (Syd.), D.M.R.E.

Radium in Superficial Face Lesions. W. A. Chernosky. Texas St. Jour. Med., December, 1930, XXVI, 573.

The application of radium to superficial lesions of the face is usually a simple procedure, though sometimes tedious when cosmetic results are borne in mind. The operator's skill may be taxed to destroy a large growth without unnecessary injury to surrounding healthy tissue. In early lesions radium gives good results, with minimum scarring. The use of radium, being harmless and painless, encourages patients to apply early for treatment. If the radium treatment is not successful, surgical measures may be resorted to without detriment to the patient. By combining the two methods, or using radium post-operatively, the percentage of permanent cures may be increased.

W. W. Watkins, M.D.

Contribution to the Radium Therapy of the Bleeding Nipple. Fritz F. Dautwitz. Strahlentherapie, 1930, XXXVIII, 710.

The history of two women is related, who were treated with gamma rays of radium 12 and 17 years ago for bleeding nipple. The total doses applied amounted to 20,729 mg.-hrs., given during a period of five years, and 26,950 mg.-hrs. given during three and one-half years. Both patients are still well to-day. In doubtful cases and those in which operation is refused, the author suggests that radium therapy should be given a trial.

Ernst A. Pohle, M.D., Ph.D.

ROENTGENOTHERAPY

A Note on the Treatment of Erysipelas by X-rays, with an Account of Three Cases. R. Hillhouse Jamieson and F. Hernaman-Johnson. British Med. Jour., Jan. 10, 1931, No. 3653, p. 57.

The value of X-ray therapy as an agent capable of cutting short the acute stage of erysipelas, was first advocated by Platau, Schlitz, and Collins. In the present account, the course of the disease in a case treated in the usual way by local applications and serum, is contrasted with two cases treated by the X-ray. In the first case the temperature fell by lysis, and in those treated by the X-ray by crisis, and the improvement in both the local and general condition was dramatic. How these very small doses accomplish their purpose is uncertain, but it would seem to be due to a stimulation of the local and general

resistance. It is not due to any direct destruction of germs.

It is concluded that, as regards erysipelas, the authors have in the X-ray a powerful weapon which can be confidently recommended in any case which causes anxiety to the doctor or the patient.

WALLACE D. MACKENZIE, M.D.

On the Question of the Distribution of Roentgen-ray Intensity in the Human Body in Deep Therapy. I.—Critical Review of the Problem and its Principles. M. Dorneich. Strahlentherapie, 1930, XXXVIII, 591.

This is the first of a series of articles dealing with the problem of isodose curves. The literature of the past, concerning the subject, is analyzed and the fundamental principles of the measuring methods are discussed.

ERNST A. POHLE, M.D., Ph.D.

The Roentgen Treatment of Metastasis to the Vertebræ and the Bones of the Pelvis from Carcinoma of the Breast. Eugene T. Leddy. Am. Jour. Roentgenol. and Rad. Ther., December, 1930, XXIV, 657.

The author maintains the fact that carcinoma of the breast may metastasize early is not taken seriously enough in clinical practice, for the spine or pelvis may be the seat of trouble for a long time, without other lesions and without symptoms or apparent change in the patient's condition. Hence, the high incidence of skeletal metastasis makes it an important problem for the pathologist, the internist, and the radiologist. The author believes that metastasis from carcinoma of the breast reaches the pelvic and vertebral bones, probably by a combination of aberrant and reflux spreads through the lymphatics, and is often accompanied by an inflammatory reaction of non-infectious origin, the most common symptom being pain in the right sciatic nerve. Treatment by roentgen rays by an effect on both the inflammatory and malignant cells in the metastatic growths, produces analgesia, often complete and of months' duration, and is the best method of palliating a hopeless disease. Several tabulations are included in this paper.

J. E. HABBE, M.D.

A Simple Field Selector in Roentgen Deep Therapy. Georg Heinrich Schneider. Strahlentherapie, 1930, XXXVIII, 762.

This is a description of a simple arrangement which facilitates the selection of fields in roentgen therapy. Its principles consist of a frosted glass plate bearing a co-ordinate system in centimeters. The anatomical cross-sections and isodose curves can be placed under the plate.

ERNST A. POHLE, M.D., Ph.D.

Roentgen Therapy of the Spine in Skin Diseases. A. Krynski. Strahlentherapie, 1930, XXXVIII, 730.

Gouin has recommended superficial roentgen therapy directed to the spinal region in order to influence certain skin diseases. He uses roentgen rays of little penetration because he wishes to affect only the superficial nerves and not the deeper lying spinal cord. The author employs a modified technic: 150 K.V., 3 mm. Al, 4 H per field (approximately 350 r), 30 cm. F.S.D. Each field is 10 cm. long; the upper area is centered over Th. 2-3, the lower area over Th. 12. Treatments are given at three weeks' intervals. If after three exposures there is no response, an interval of from 6 to 9 weeks is advisable. In conclusion, the author states that this treatment is the method of choice in cases of lichen ruber planus. He also cured two severe cases of dermatitis herpetiformis. Definite improvement was seen in patients with neurodermatitis, eczema, and pruritus. The only reaction following the treatment consisted in sweating and slight nausea on the following day.

ERNST A. POHLE, M.D., Ph.D.

Radiation Therapy of Thrombophlebitis. Josef Halban. Wien. klin. Wchnschr., Nov. 6, 1930, XLIII, 1368.

The roentgen treatment of inflammatory diseases has been established since Heidenhain and Fried published their results. The author

used the following treatment in seventeen cases of thrombophlebitis: 180 K.V., 3 ma., a filter of 0.5 mm. Zn and 2 mm. Al, and a distance of 28 centimeters. About 15 per cent of a skin erythema dose was given, and several fields were used when the phlebitis extended over considerable length. The results were very gratifying. The pain, which is often very severe, disappeared shortly after the treatment, the swelling receded rapidly, and the recovery of the patient was hastened. The results were so good that all such cases were submitted to roentgen treatment. One must be very careful in moving a patient and should, if possible, transport him only in his own bed, as lung emboli are always to be feared.

H. W. HEFKE, M.D.

Relative Value of Roentgen and Radium Therapy. R. H. Crockett. Texas St. Jour. Med., December, 1930, XXVI, 578.

Two very elementary but important questions are often asked by referring physicians and patients, *viz.:* "Just what good will X-ray or radium treatment do?" "Which is the better, X-ray or radium treatment?" Without a categorical answer to these questions, the author discusses many conditions in which radium or the X-ray may be used and his usual practice in choosing the type of radiation. The discussion covers fibroids of the uterus, malignancy of the breast (in which he advocates pre-operative and post-operative radiation, the latter including three cycles of treatment), and malignant conditions in general.

W. W. WATKINS, M.D.

Deep Roentgen-ray Therapy of Mammary Carcinoma. II.—Five-year Results: Value of the Method as an Auxiliary to Surgical Procedures in the Operable, and as a Primary Procedure in the Inoperable Cases. William A. Evans and T. Leucutia. Am. Jour. Roentgenol. and Rad. Ther., December, 1930, XXIV, 673.

In 1925, the authors presented their first experiences with deep roentgen therapy in carcinoma of the breast, giving, in detail, their method of procedure and the technic of irradiation in both the operable and inoperable cases. Analysis showed that roentgen therapy in its new, short wave length application forms one of the most powerful agents in the treatment of mammary carcinoma. In this present article a detailed statistical account is submitted of the five-year results obtained in the previous series. These statistical results are presented in the form of tabulations, there being thirteen.

The authors conclude that roentgen therapy in its short wave length application is of considerable aid in the treatment of operable mammary carcinoma as an auxiliary to surgical procedures. In the cases without glandular involvement, the addition of irradiation does not noticeably increase the five-year results above those of surgery alone. However, in the cases in which the carcinoma has already spread to the axillary or the high thoracic lymph nodes, the five-year results are nearly doubled. The best method of procedure is considered to be a combination of radical surgery, with a systematic irradiation of the entire anterior thorax, axilla, and neck on the diseased side. In the inoperable or recurrent mammary cases, roentgen therapy produces prolongation of life and alleviates the symptoms.

J. E. HABBE, M.D.

Our Experience with the Protracted Fractional Roentgen Treatment of Coutard. A. Kahlstorf and A. Zuppinger. Strahlentherapie, 1930, XXXVIII, 199.

Since April, 1929, the authors have treated 52 cases of far advanced malignancies with the method of Coutard. A potential of 170 K.V., filter of 0.45 mm. chrome iron, plus 1.0 mm. copper, plus 1.0 mm. aluminum, giving a half value layer in copper of 1.113 mm., were used. The F.S.D. varied from 60 to 100 cm., while the single dose amounted to about 150 r; treatments were given daily over a period of from three to four weeks. The total doses applied were between 4,800 and 7,200 r, as measured in air.

All cases are discussed in detail, giving the essential parts of the history and the outcome.

Many photographs of patients accompany the article. In spite of the fact that the authors were dealing with advanced cases, they were able to obtain temporary cures in nine cases. The reactions of the skin and of the mucosa following this type of treatment are entirely different from those customarily observed after single heavy doses. These reactions are described in detail and a number of photomicrograms show the histological characteristics. Since this method employs such high total doses, a very careful observation of the reactions is essential in order to prevent acute or latent injuries. In many cases, the regression of the tumors started several days after the beginning of the treatment. Cases with a recurrence did not respond to additional treatment, as a rule. In such patients, it is better, provided the procedure can be carried out, to remove the remaining tumor by electrocoagulation. When treating tumors within the mouth, great caution must be used in order to prevent bone necrosis. The removal of teeth after the treatment is not advisable. Although it is impossible to report end-results obtained with this treatment method, the authors feel that it should be studied further in inoperable cases of neoplasms.

ERNST A. POHLE, M.D., Ph.D.

Radiation Therapy of Polycythemia Vera. George T. Pack and Lloyd F. Craver. Am. Jour. Med. Sci., November, 1930, CLXXX, 609.

Polycythemia may be functional (altitude, fright, dehydration, etc.) or essential (polycythemia vera). Polycythemia with splenomegaly is the common type, and, in this, irradiation is the treatment *par excellence*. The disease is due to overproduction of the red cells by the bone marrow, and failure of the cell-destroying mechanism of the body to keep pace with production. Polycythemia is a clinical analogue of myelogenous leukemia, and treatment should be directed to the radiosensitive marrow cells. Splenectomy is contraindicated, and radiation is superior to chemical agents. Since the locus of the disease is in the bone marrow, sufficient irradiation should be given to inhibit or depress but not to destroy erythropoiesis. The dosage must be exact, and will depend on the severity of the illness. The treatment must be carefully controlled by observing the condition of the patient and the number of leukocytes. Both long and short bones may be treated, but particularly the long bones; the head and the pelvis should not be treated, to avoid alopecia and effect on the gonads. The irradiation prevents the formation of new erythrocytes, and is not designed to destroy red cells already formed. The suggestion has been made that stimulative doses should be applied to the spleen to increase cell destruction, but these authors question the value of this. Some interesting case reports are given in detail.

W. W. WATKINS, M.D.

The Effect of Roentgen Rays on the Eye. W. Rohrschneider. Strahlentherapie, 1930, XXXVIII, 665.

The author, who has done a considerable amount of experimental work of his own concerning the effect of radiation on the eye, discusses critically the literature on the subject. He summarizes our knowledge in a tabulation which gives the tolerance and injurious doses for the various parts of the eye, as compared with the epilation dose. It appears that the lens is most sensitive, since an epilation dose represents its tolerance. Conjunctiva and cornea tolerate from 20 to 30 per cent more than the so-called erythema dose. The margin of safety is greater for heavily filtered radiation. In conclusion, the author emphasizes that he does not wish to discourage the use of roentgen rays or radium in diseases of the eye, but merely wishes to draw attention to the fact that caution is necessary in prescribing radiation therapy in ophthalmology.

ERNST A. POHLE, M.D., Ph.D.

Roentgen Treatment of Hyperthyroidism. Wright Clarkson. Virginia Med. Monthly, November, 1930, LVII, 498.

The mortality in surgical treatment of hyperthyroidism has been reduced to 1 per cent in the hands of the best surgeons, but a method which will give as good results as surgery

should be welcome. Reports in medical literature indicate that irradiation is a worthy rival of surgery in treating hyperthyroidism. The very conservative report of Groover, Christie, Merritt, Coe, and McPeak on 305 patients showed more than 88 per cent cured, and only 2.5 per cent unimproved. The author's technic is high voltage, heavy filter, and short exposures at intervals of from ten days to three weeks. Care should be taken to include the thymus in the radiation. The general care of the patient is important, with bed rest for acutely ill patients, removal of foci of infection, and the treatments controlled by frequent basal metabolic tests.

W. W. Watkins, M.D.

Roentgen Therapy of Tabes. Curt Kremser. Strahlentherapie, 1930, XXXVIII, 719.

Forty-four patients suffering from tabes were treated by roentgen rays. The technic is as follows: 180 K.V., 4 ma., 0.5 mm. Cu, 23 or 30 cm. F.S.D., one-third E.D. per field. In the first group, two lateral fields and one posterior field over the spine were given. The total dose in the cord amounted to from 70 to 90 per cent E.D. In the second group, two oblique fields, one to the left and one to the right of the spine, were applied, one-third E.D. per area. The third group received one field directly over the spine, one-third E.D. per treatment. In the fourth group, the technic of the second and third groups were combined. In 11 cases there was no effect at all upon the symptoms, particularly the pain. Four patients were slightly improved, 20 showed a temporary improvement, and only 9 obtained improvement over a longer period. In the opinion of the author, roentgen therapy may, therefore, be used as a symptomatic agent in tabes, but apparently does not influence the pathological process.

Ernst A. Pohle, M.D., Ph.D.

The Effect of High Voltage Roentgen Radiation (200 K.V.) upon the Fertility and Motility of the Sperm of the Rabbit. Sydney A. Asdell and Stafford L. Warren. Am. Jour. Roentgenol. and Rad. Ther., January, 1931, XXV, 81.

Twenty-two full grown female rabbits were used in these experiments. It has been found that ovulation in rabbits occurs about ten hours after copulation. For fertility studies, does were allowed to copulate with vasectomized bucks. One hour later these does were artificially inseminated with irradiated or control spermatozoa. Sperm for artificial insemination and for motility experiments was obtained by sacrificing a doe which had just copulated with one or more vigorous normal bucks. The abdomen was opened, the semen obtained and immediately divided into two equal portions and placed in two thin petri dishes, one portion being given large amounts of radiation consisting of all the wave lengths in unfiltered or filtered beams of radiation produced at from 100 to 200 kilovolts. Motility studies of the sperm during these experiments gave no indication of any change resulting from the irradiation. Two litters of apparently normal young were obtained by artificial insemination with irradiated sperm.

J. E. Habbe, M.D.

SINUSES (DIAGNOSIS)

Roentgen Examination of the Paranasal Sinuses and Mastoids. Amédée Granger. Jour. Am. Med. Assn., Nov. 1, 1930, XCV, 1332.

The author, from experimenting and after seven years' practical experience, is convinced that roentgenograms made in other positions do not show the same constant and clear anatomic boundary landmarks for the sphenoids, ethmoids, and paranasal sinuses, as those made by his method described in 1923. For the examination of the mastoid regions, roentgenograms were made in the position recommended by Law, and in the position described by the author in 1926. The Granger roentgenogram gave a more detailed view of the anatomy of the mastoid region and process, with fewer structures superimposed. It showed the different groups of cells, including the tip cells, much more distinctly; the superior semicircular and internal auditory canals;

the sharp outline of the mastoid cortex; and in this view the course of the external auditory canal is away from and does not overlie the shadow of the mastoid cells. Labyrinthitis has been diagnosed in several instances, to be confirmed by the usual otologic tests. A pre-operative diagnosis of tumor of the acoustic nerve was made in two cases. In infants and children under six years of age, the Law position is the only one that can be satisfactorily employed. The author summarizes his observations on an intensive study of roentgenograms of children presented in 1929.

C. G. SUTHERLAND, M.D.

Osteoma of the Frontal Sinus. R. O. Leavenworth. Laryngoscope, December, 1930, XL, 885.

The literature up to 1926 shows 117 reported cases of osteomas of the frontal sinus. The tumors are most often encapsulated with a pedicle, but a few are ordinary exostoses. Numerous cases are on record in which the pedicle has become detached, causing what is termed a "dead osteoma." Occasionally there is an associated mucocele, and frequently a complicating acute frontal sinusitis. Osteomas are essentially benign and usually slow-growing, although they may increase their rate of growth and develop in a matter of weeks more than they did in the several previous years. The serious aspects are produced by pressure and encroachment into the cranial cavity and the orbit, as well as the frequent complicating acute frontal sinusitis. The diagnosis is, of course, by the X-ray.

A case is reported, diagnosed by the X-ray, of the exostosis type. The patient was operated on for relief of the frontal sinusitis, but the osteoma was not disturbed. The author has followed the case for seven years, and the growth of the osteoma has been only one-fourth of an inch. The patient is now symptom-free and has been so since the operation for the acute frontal sinusitis. The author does not think the removal of osteomas is usually indicated, as it is difficult to make a couple removal because of frequent origin in the ethmoid cells, and there are many reported cases showing a recurrence with a faster growth-rate after partial removal. There is further danger in operating because extensive exposure of the dura may be necessary. If there are very serious symptoms from pressure and extension of the growth, extirpation of the osteoma should be attempted, and the prognosis with present surgical methods is good.

H. RUDISILL, JR., M.D.

Chronic Antrum Disease. L. E. Patrick. Northwest Med., July, 1930, XXIX, 307.

Antrum puncture with a trocar, and washing, is the least reliable procedure in making a diagnosis of chronic infection, unless a microscopic examination of the fluid is made. In acute infections it is quite valuable. In chronic disease, puncture, with cytological examination as described by Sewall, is of value. The roentgen ray is the most important single factor in determining the pathology present, but, taken alone, is often misleading. Lipiodol as a contrast medium has not been very successful in the author's hands.

W. W. WATKINS, M.D.

The Interpretation of Sinus Roentgenograms. G. W. Grier. Am. Jour. Roentgenol. and Rad. Ther., July, 1930, XXIV, 21.

The author emphasizes the value of stereoscopic postero-anterior views taken at three angles and supplemented by supero-inferior, lateral, and Granger projections.

Sinus pathology being dependent upon variations in the normal transparency, these densities have been classified as local and general. Localized areas of density may be produced by osteoma, fibroma, polyp, mucocele or cyst, hyperplasia of lining mucous membrane, or malignant newgrowth. Osteomata and fibromata are not as a rule distinguishable. Polypi, mucoceles, and cysts are likewise difficult to differentiate, but here the rhinoscopic findings should assist. The fuzzy or clean-cut appearance of the inner margin of a thickened lining membrane may aid in determining active or la-

tent sinus disease. Post-operative cases, especially antra, often show residual opacities. The only roentgen sign strongly suggestive of malignancy is erosion of bone in the vicinity of the tumor. Generalized densities of one or more sinuses, if pronounced, are usually due to empyema, extensive polyposis, or newgrowth. In differentiating the first two conditions, if there is ethmoid involvement a widening of the ethmoid regions is suggestive of polyposis.

The author has very rarely been able to demonstrate fluid levels in any of the sinuses. Slight uniform densities of the sinuses are observed in congestion of mucous membrane, old thickening of membrane of slight degree, post-operative cases, suppurative sinusitis where the pus is well drained out, and chronic hyperplastic sinusitis. Differentiation in such cases is quite impossible by the X-ray alone, but usually may be accurately made if the history is correlated with the rhinoscopic and roentgenologic findings.

J. E. Habbe, M.D.

SINUSES (THERAPY)

The Diagnosis and Treatment of Inflammation of the Maxillary Antrum. Perry G. Goldsmith. Canadian Med. Assn. Jour., October, 1930, XXIII, 512.

In the great majority of instances the mucosal inflammation of the maxillary antrum is caused by acute rhinitis. It is also associated with external violence, operations, abscessed teeth, infection of ethmoids and frontals, septal deflection, and enlarged turbinates as causative factors.

The symptoms of acute antral inflammation are excessive purulent nasal discharge, pain in the face (increased on leaning forward), and some tenderness in the canine fossa. Additional diagnostic agents are transillumination and diagnostic puncture. The X-ray is not needed in the acute cases. The author places great reliance on transillumination. Puncture of the antrum is valuable in the acute cases, but not so valuable in the chronic cases, where secretion does not always form the main pathologic process.

The treatment of the acute condition depends on its degree. In such cases irrigation should be employed until the secretion becomes more gelatinous, or changes into a lemon-colored mucoid mass. If, however, after some weeks, the nasal or post-nasal discharge still persists, improved facilities for drainage and ventilation should be secured. This is accomplished by enlarging the drainage opening, followed by continued irrigation, and the instillation of neo-silvol or zinc sulphate, or even by ionization, which may be helpful.

The symptoms of chronic antral inflammation consist of chronic discharge, which may be thin and scanty, and of varying degrees of nasal obstruction, due to enlargement of the turbinate mucosa. The patient has frequent head colds, and sneezes.

The pathologic process is of a deeper character than in the acute condition. The deeper structures of the antral mucous membrane are attacked. Cysts are more common. Irregular edematous masses and diffuse hypertrophies are frequent.

The diagnostic measures used in the chronic condition are much the same as in the acute, with the addition of the X-ray. The information required from the X-ray examination pertains more to the character of the mucous membrane. This information is obtained better if the antrum is injected with lipiodol and olive oil (1-3), or bismuth in paroline.

The treatment of the chronic condition consists in attention to the general health, such as change to a warmer climate, and the securing of better nasal ventilation and drainage. These measures may involve straightening of a deflected septum or removal of the anterior end of the middle turbinate. If this does not suffice, increased drainage may be secured by enlarging the exploratory opening and repeated irrigation. If irrigation and ventilation do not effect a cure, the infected antral mucous membrane should be removed entirely through an opening made under the lip through the canine fossa.

L. J. Carter, M.D.

The Rational Surgical Treatment of Chronic Antral Disease. John G. Hunt. Canadian Med. Assn. Jour., September, 1930, XXIII, 386.

Operations for chronic maxillary sinusitis are now almost as common as those for chronic tonsillitis, thanks to the simplification of the diagnosis by the radiologist. With the advent of iodized oil, preliminary to radiography of the antra, it is now possible to tell at a glance, not only if the sinus is diseased, but also to say with a considerable degree of accuracy the type and degree of pathological change present in the lining mucosa, whether fibrous, polypoid, or purulent. This point is illustrated by five excellent reproductions of radiographs. Chronic maxillary sinusitis plays a large part as a causative factor in "chronic catarrh," chronic eye, ear, and pulmonary conditions, chronic headache, neurasthenia, and arthritis.

The indications for treatment are determined by the type of pathology present. The three types of treatment employed are the intra-nasal, the naso-antral, and the extra-nasal methods.

The intra-nasal method is based on the nasal obstruction theory as the cause of maxillary sinusitis, but fails usually because it ignores the local focus in the antrum.

The naso-antral method has the largest following. It consists in making a drainage opening from the lowest part of the antrum into the nasal cavity. It is of value only when free pus is present, and then often fails. If polypi are present the use of this method is indefensible.

The advocates of the extra-nasal method regard nasal obstruction and high antrum opening as quite irrelevant factors. They feel that, provided the nasal or remote symptoms are such as to demand operative interference, and the X-ray shows considerable increase in the mucosal density, the rational procedure is the complete extirpation of the infected mucosa. To do this it is necessary to have access to all parts of the antral cavity. Adequate approach through the nose being impossible, the simple expedient of temporarily elevating the buccal mucous membrane and removing enough of the external bony antral wall was adopted.

The modern surgeon does not do the radical operation of complete ablation of the antral cavity, as advised by Caldwell and Luc, the pioneers of this operation. Only sufficient bone is removed to permit the excision of all diseased tissues, and a flap of nasal mucosa is turned into the cavity to provide a nucleus for the subsequent epithelialization. This method gives gratifying clinical results. It should not be used during an acute exacerbation of the infection.

L. J. Carter, M.D.

SKIN (THERAPY)

The Action of Roentgen and Ultra-violet Rays on the Reticulohystiocytic System of the Skin. Pietro G. Castellino. Archivio di Radiologia, July-October, 1930, VI, 681.

The author irradiated the backs of rabbits, with single varying doses of roentgen and ultra-violet rays, injected a vital stain (trypan-blue), and examined specimens from the fields irradiated at varying intervals. He found, histologically, a difference in effect, due, probably, to the difference in quality (penetrability) of these two types of radiation and the doses used.

E. T. Leddy, M.D.

The Need of More Conservative Roentgen Dosage in Skin Disease. W. F. Spiller. Texas St. Jour. Med., December, 1930, XXVI, 582.

The author discusses some unfortunate results often seen following radiation of the skin, and believes the remedy is in the more careful and conservative use of the X-ray. In benign conditions, he follows the MacKee technic of fractional skin doses. In malignant skin lesions he is opposed to massive doses, and thinks it is better to give second doses than to over-treat. He thinks that an accurate diagnosis should precede the use of the X-ray, that

the least amount of X-ray necessary for a good result should be used, that if a case does not respond well to X-rays some other method should be substituted, and that it is better not to use X-rays at all than to produce a radiodermatitis.

W. W. WATKINS, M.D.

Multiple X-ray Carcinomas Following Psoriasis: Case Report and Comment. Herman Goodman and Charles W. Price. Arch. Phys. Ther., X-ray, Radium. May, 1930, XI, 209.

This is a case report in which an examination revealed typical psoriatic patches over the extensor surfaces of the extremities and on the back. In addition, there was a radiodermatitis of the psoriatic regions of the arms and legs (120 square inches of radiodermatitis). Pathologic study from a section of an ulcer of the dermatitis showed it to be prickle-cell epithelioma. The psoriatic lesions developed 28 years ago. Six years ago the lesions were cleared up by twelve X-ray exposures. Shortly, the lesions reappeared and the patient received further X-ray exposures every 7 to 14 days for over a year. The disease became worse and ulcerated six months ago.

Arthur Alexander reported 18 cases of carcinoma on the basis of pre-existing psoriasis, 11 as arsenical carcinomas, and 7 as pure psoriasis carcinoma. This would indicate a feature of unrest in a psoriatic skin. MacKee has said that if psoriasis does not clear up after three treatments of one-fourth skin unit per week, that some other treatment should be instituted. From the authors' preliminary work it seems that an over-radiated skin can be detected early by filtered ultra-violet light.

HERMAN GOODMAN, M.D.

SKULL (DIAGNOSIS)

The Technic of Encephalography. Carl D. Camp and R. W. Waggoner. Arch. Neurol. and Psychiat., January, 1931, XXV, 128.

The authors state that there are two profound objections to encephalography: First, the severe reaction which the patient experiences during and after the injection of air; second, the danger of this procedure in cases with increased intracranial pressure. To overcome part of this unfavorable reaction which is dependent, to some extent, upon the amount the patient is moved, they describe a new chair which permits the patient to occupy the horizontal position during the puncture. The chair may also be so adjusted as to allow the patient to rest in the vertical position. It is described in detail, as is also a combination tube-stand and Bucky diaphragm.

C. G. DYKE, M.D.

Calcification of the Cerebral Falx. Giovanni Balestra. Archivio di Radiologia, July-October, 1930, VI, 731.

The author reports two cases showing, respectively, a large isolated area of ossification and multiple calcifications of the falx. He gives points of differentiation between the roentgenologic findings in ossification (osteomas) and granular calcification. He emphasizes the importance that granular calcifications have in regard to isolated osteomas, especially if they are not limited to the falx.

E. T. LEDDY, M.D.

Intracranial Calcification, with Particular Reference to that Occurring in the Gliomas. Cyril B. Courville and Leo J. Adelstein. Arch. Surg., November, 1930, XXI, 801.

The literature in regard to intracranial calcification of various kinds is quite well covered, and it is shown that calcareous deposits may be found in practically every type of primary intracranial new growth, with the exception of the craniopharyngeal cysts. It is probably most common in the gliomas. This calcification is of considerable value in the roentgenographic examination of the skull, as the distribution of the calcareous material is usually evenly spread throughout the tumor tissue and gives some conception as to its size and relationship. There may be such a small amount of calcification present that it is not shown on the roentgenogram. Roentgen examination usually reveals an associated thinning of the skull over the tumor, indicating a

local, rather than a general, increase in pressure.

Twelve cases are reported. Of the ten growths verified histologically, five proved to be neuroglia-blastomas, three were astrocytomas, one was an ependymal glioma, and one, an unclassified glioma, apparently a cerebral medullo-blastoma.

HOWARD P. DOUB, M.D.

Congenital Cerebral Cysts of the *Cavum Septi Pellucidi* (Fifth Ventricle) and *Cavum Vergae* (Sixth Ventricle): Diagnosis and Treatment. Walter E. Dandy. Arch. Neurol. and Psychiat., January, 1931, XXV, 44.

The author calls attention to the anatomical relations of these two structures, and reports two cases in which the *cavum septi pellucidi* and *cavum vergæ* were markedly dilated with fluid. This was proved by operation. He states that separation of the anterior horn and body of the lateral ventricles, as seen in the ventriculogram, is pathognomonic of the condition. Reproductions of the ventriculograms of these cases accompany the article.

C. G. DYKE, M.D.

Traumatic Pneumocephalus. S. W. Miller, R. N. Klemmer, and P. O. Snoke. Jour. Am. Med. Assn., Jan. 17, 1931, XCVI, 172.

One case is reported because of the great damage sustained by the cerebrum, with at least temporary infection, the associated introduction of air into the ventricles, operation, and complete recovery.

In 1926, Dandy reported three cases of intracranial pneumatocele and, in reviewing the literature, found twenty-five other cases. Of these twenty-eight patients, eight definitely had air in the ventricles. In several others there was considerable doubt as to the location of the air. Observers, in explaining the mechanics of the introduction of intraventricular air, presupposed valve action, permitting egress of fluid and ingress of air. Dandy believes an additional factor, such as sneezing, coughing, straining, or even swallowing, is necessary to force the air from a sinus through rents in the bone and dura into the brain proper.

The important instructive features of the case were: (1) Increasing headache, in a patient with fracture of the skull, should call for roentgenographic re-examination; (2) patients with fracture of the skull involving a sinus should be instructed never to blow the nose; (3) cerebrospinal fistula usually demands operative intervention; (4) the roentgenogram is diagnostic.

CHARLES G. SUTHERLAND, M.D.

Hypophyseal Lacunar Dysostosis. Mario Santoro. Archivio di Radiologia, July-October, 1930, VI, 713.

The author describes the case of a boy who had diabetes insipidus. On roentgen examination of the sella turcica, he found a lesion (illustrated in the article) in the cranial bones and similar ones in the ribs, pelvic bones, left humerus, and both femurs. They were at first thought to be due to faulty calcium metabolism secondary to the pituitary lesion, but further examination demonstrated active pulmonary tuberculosis, which the author regards as the most probable cause of the bone changes.

E. T. LEDDY, M.D.

SPINE (DIAGNOSIS)

Roentgenologic Findings in a Series of Seventy-two Cases of Traumatic Myelitis Due to Fracture of the Spine. E. S. Gurdjian. Am. Jour. Roentgenol. and Rad. Ther., January, 1931, XXV, 65.

Although at times very difficult to obtain, the author believes that roentgenograms of all cases of acute spine fractures should be made before any operative procedure is considered. It is important to have good lateral films, being particularly careful, when studying the cervical region, to include the seventh cervical and first dorsal vertebræ. The majority of the cases described had injury at the lower cervical, lower dorsal, and upper lumbar levels. Compression fracture of the cervical vertebræ is not infrequent, and several instances of this

type are described. Longitudinal fracture through the bodies of the vertebræ is a possibility and can be diagnosed from the roentgenogram. The involvement of the spinal cord in fractures of the spine may be either direct or indirect. In the series presented, central softening and hematomyelia were found most frequently in fractures in the cervical region. Edema of the cord after injury is a definite pathologic entity, and is probably responsible for excessive destruction of cord substance. The author concludes that it would, however, be a grave mistake to depend upon roentgen examinations alone.

J. E. Habbe, M.D.

Double Isolated Compression Fracture of the Spine. Chester C. Schneider. Jour. Bone and Joint Surg., July, 1930, XII, 595.

The author states that there have been only twelve reported cases of multiple compression fracture. He adds three more cases which have followed serious accident, and in all of these the involvement is in the thoracic column.

Paul C. Hodges, M.D.

Disabling Back Pain: Differential Diagnosis and Treatment. Robert McE. Schauffler. Jour. Am. Med. Assn., Dec. 6, 1930, XCV, 1717.

In considering disabling back pain one must be sure there is no gross lesion, such as a compression fracture of a vertebra or a fracture of the transverse or spinous processes, destructive bone lesion, such as tuberculosis or cancer, or root pain from locomotor ataxia, tumor, or other lesion of the spinal cord. Reflex pain, due to disease or displacement of some viscus, malingering, or a psychoneurosis must be ruled out. Good roentgenograms, both antero-posterio and lateral, will give definite information. Asymmetry of the spine alone is seldom the cause of pain. An increase of the lumbosacral angle might cause chronic strain and pain. Occasional cases of true spondylolisthesis are revealed. The displacement is usually between the fifth lumbar vertebra and the sacrum, or it may be between the fourth and fifth lumbar vertebræ. It must be apparent in the lateral roentgenogram to justify the diagnosis. Congenital malformations of the spine may be puzzling as to whether or not they are the cause of the back pain. Misshapen vertebræ usually lead to deformity early in life, the patient having an abnormal curve of the spine for years. Spina bifida occulta is seldom a cause of back pain. Complete sacralization of the fifth lumbar transverse processes rarely causes symptoms. Unilateral sacralization of the fifth lumbar transverse process is more likely to cause pain because of the unbalance of the spine. Impaction of the transverse process of the fifth lumbar vertebra is seldom a cause of pain. In middle aged or old persons, the roentgenogram often shows hypertrophic arthritis, with rims or spurs in the more advanced cases. One has quite a problem to decide whether or not these changes are the cause of pain.

Comparative data in different series of patients, giving the numbers in which the roentgenographic findings were positive and diagnostic, and in which they showed lesions considered only coincident, are instructive. When there is doubt as to the interpretation, the spine should be immobilized and new films should be made after a two months' interval. The necessity for correlation of a carefully elicited history and comprehensive observation with the roentgenographic findings is stressed.

Treatment is reviewed in all its phases. If other conditions improve but the low back pains remain at the end of six months, hysterectomy in women, and mobilization of the cecum in both sexes, is indicated.

Charles G. Sutherland, M.D.

Spondylolisthesis. Henry W. Meyerding. Jour. Bone and Joint Surg., January, 1931, XIII, 39.

The author summarizes the findings in 121 cases of spondylolisthesis seen at the Mayo Clinic in the last twelve years. Trauma was a factor in 40 per cent of the cases in which two-thirds were males. Roentgenograms are considered essential aids in making a diagno-

sis. It is practically never possible to reduce the deformity even when it has been caused by recent injury, but the symptoms are relieved by immobilization either by means of belts or by surgical fusion of the lower lumbar vertebræ and the sacrum.

PAUL C. HODGES, M.D.

The Roentgenogram of Spondylitis Typhosa. Julian Arendt. Röntgenpraxis, Dec. 1930, II, 1080.

The spondylitis which follows typhoid is a rather rare disease, only about one hundred cases having been published in the literature. The roentgenologic appearance is dependent on the severity of the lesion and may easily be mistaken for tuberculosis of the spine. Changes in the intervertebral discs and areas of destruction in the vertebræ are commonly seen in a "typhoid spine." Abscesses are not present around the area of infection, the localization usually being in the lumbar spine.

H. W. HEFKE, M.D.

THYMUS (DIAGNOSIS)

Roentgenology of the Thymus in Infancy and Differential Diagnoses of Enlarged Thymus and its Treatment. Henry K. Pancoast. Am. Jour. Med. Sci., December, 1930, CLXXX, 745.

This is a very comprehensive article in which the stand is taken that the size of the gland is not the important factor but the thymic menace in infants is largely a matter of tracheal stenosis, aided by relaxation of the soft tissues of the upper respiratory tract. The roentgenologic evidences of thymic enlargement are often erroneous, the only reliable sign of an enlarged or dangerous gland being the buckling of the trachea at the thoracic inlet as it passes over the apex of the gland. This is shown only in a lateral view of the chest, and in the lateral deviation of the trachea in the sagittal view. Unusual width of the shadow is of no particular significance.

Accurate studies of the chest and upper respiratory tract of infants and young children must be based on two important factors, namely, a uniform and comprehensive technic capable of being reproduced in every instance, and in normal standards for different ages. The technic is described in detail for the taking of films in the erect and horizontal positions, in both sagittal and lateral views. It is essential to examine all thymic suspects in two phases of respiration, if any comparative measurements are to be made. Differential diagnosis is important, and this must not be overlooked just because an enlarged thymic shadow is found. The following conditions have been found in patients suspected of having thymic symptoms: foreign bodies, retropharyngeal abscess, tracheal and laryngeal stenosis, adenoids, asthma, whooping cough, meningitis, congenital heart conditions, congenital atelectasis, collapse of soft tissues, and recurrent laryngeal paralysis.

In the treatment of the gland by irradiation, we are dealing with a lymphatic structure which is extremely susceptible to irradiation, and only sufficient dose should be given to reduce the gland to a safe size. In very early infancy from one-tenth to one-fourth of a mild erythema dose should be given, at 130 K.V., 5 mm. aluminum, nine-inch skin distance, with a slightly larger dose for older children.

W. W. WATKINS, M.D.

Roentgen Diagnosis and Treatment of Enlargement of the Thymus. Eugene P. Pendergrass. Pennsylvania Med. Jour., September, 1930, XXXIII, 860.

There are certain definite and well founded facts concerning the thymus which are not sufficiently well known and which deserve consideration. The author concurs in the views of Jackson that thymic menace is largely one of tracheal compression. Any roentgenologic technic undertaken in the study of the thymus must include the upper respiratory tract, and also a preliminary fluoroscopic study in essentially the same positions as the roentgenographic views. Sagittal views are made on a low table, with the infant prone upon the cassette. The tube distance is 38 inches and directly over the suprasternal notch. One attendant holds the lower extremities and hips;

another holds the upper extremities above the head, which must be exactly straight, without the slightest rotation to either side and midway between flexion and extension. Exposures can be made in 1/20 sec. and 100 ma. or faster if desired. One exposure is made during expiration and one during inspiration, the child being made to cry for the sake of deeper inspiratory effort. An exact lateral view is also required, the arms being held downward and back, the shoulders thrown as far forward as possible. Use twice the exposure above mentioned, also during expiration and inspiration.

As a result of some experimental work, the author concludes that exposures should also be made in the erect position, an adaptable chair having been devised for this purpose.

In considering radiation therapy of the thymus, it is recalled that the gland is extremely susceptible to radiation, symptoms of enlarged thymus sometimes disappearing after an ordinary X-ray examination. Another important observation, not always remembered, is that the gland can regenerate in from five to ten days. Conservative treatment is advocated, giving from ⅓ to ¼ of an erythema dose over the thymic region, and not repeating unless the symptoms either do not disappear or return. An interval of ten days is allowed between treatments and rarely are more than four treatments required. The factors employed are: 130 K.V., 5 ma., 10 in. distance, 4 × 4 in. portal, 5 mm. Al filter, 3 to 4 min. time. Roentgen therapy is almost a specific for enlarged thymus, and if the symptoms do not disappear after several treatments, search should be made for some other cause.

W. W. Watkins, M.D.

Thymus. Douglas D. Martin. Southern Med. Jour., July, 1930, XXIII, 625.

The size of the thymus has no relation to the severity of symptoms. The thymus is variable in size, not only in different types of infants, but in the same infant at different times. There is a temporary enlargement of the thymus due to intercurrent diseases. The size of the thymic shadow varies with inspiration and expiration. This author believes that we rarely see cases which require X-ray treatment, and the presence of respiratory stridor, with enlarged thymic shadow, is not sufficient indication for X-ray treatment, without further clinical study.

W. W. Watkins, M.D.

TUBERCULOSIS (DIAGNOSIS)

The Clinical Picture of Calcification of the Mesenteric Glands. Hans Rothmann. Med. Klinik, Oct. 24, 1930, XXVI, 1596.

In some cases admitted on account of kidney and stomach symptoms, a calcification of the mesenteric glands could be demonstrated as the cause of the symptoms. All cases showed allergy towards milk and a positive skin reaction with bovine tuberculin. The roentgen examination showed calcification of the mesenteric glands. These findings led to a diagnosis of an old infection of the mesenteric glands with bovine tuberculosis.

H. W. Hefke, M.D.

Clinical and Radiologic Observations on Tuberculous Lobitis. Pietro C. Malugani. Archivio di Radiologia, July-October, 1930, VI, 763.

The author reports eight cases of tuberculous lobitis involving the right upper lobe and two involving the left upper lobe. This type of pulmonary tuberculosis is easily recognizable by (1) the opacity of the whole lobe, and (2) the sharpness of its outline, which follows the course of the line of the fissure.

E. T. Leddy, M.D.

Important Factors in the Study of Childhood Tuberculosis. Stuart Pritchard. Journal-Lancet, Sept. 1, 1930, L, 421.

This article is devoted chiefly to a discussion of the importance of contact and the use of tuberculin. Prevention of the disease is augmented by the tuberculin test, repeated physical examination, and X-ray studies. The X-ray is in reality internal inspection and a necessary part of a complete physical examination. Calcification is an excellent sign that

the child has at one time overcome at least a part of his infection, but it is not always evidence of inactivity. All children reacting to tuberculin should have serial X-ray examinations in order to anticipate developing lesions.

W. W. WATKINS, M.D.

Radiographic Aspects of Laryngeal Tuberculosis. Lorenzo Feci and Luigi Pietrantoni. La Radiologia Medica, August, 1930, XVII, 987.

The conclusions drawn by the author are as follows:

(1) The lateral projections give a clear image of the laryngo-tracheal tube.

(2) In non-laryngeal tuberculosis, the larynx presents early ossification or disseminated zones of calcification.

(3) Radiologically, tuberculosis of the larynx presents: *(a)* zones of irregular rarefactions of granular or amorphous character and blurred contours in cases of cartilage destruction; *(b)* in chronic processes there are definite opacities which obscure the normal structure of the trachea.

(4) There is no definite radiological picture which radiologists may use to diagnose the type of pathology involving the larynx. The only information which can be obtained is the extent and the shape of the lesion.

(5) Radiological control in tuberculosis of the larynx has very little value when compared to laryngoscopic examination.

L. MARINELLI.

Differential Diagnosis of Pulmonary Tuberculosis, Lung Abscess, and Bronchiectasis. F. P. McNamara. Jour. Iowa St. Med. Soc., September, 1930, XX, 421.

In making such a diagnosis, we utilize the facts derived from a systematic clinical history, a complete physical examination, supplemented by properly directed X-ray and bronchoscopic studies, and by adequate laboratory tests. Too often a history is carelessly taken, a perfunctory physical examination made, laboratory tests neglected, or physicians seem to think it is the X-ray machine rather than the trained radiologist that makes the diagnosis. From physical findings alone, it is highly improbable that an exact diagnosis can be made, and the other diagnostic aids must be depended upon. The X-ray is of the greatest value, and no diagnosis of lung disease is complete unless checked by the X-ray examination. The long controversy as to whether the X-ray or the clinical findings are the more certain, has no place to-day: a diagnosis is made on all the evidence obtainable. The X-ray will show the location of the lesion, whether it is unilocular or multilocular, whether there is cavity formation, with fluid or air, whether tuberculosis alone is present, or whether it is co-existent with another infection. In ruling out a bronchiectasis, the use of iodized oil may be necessary.

W. W. WATKINS, M.D.

The Differential Diagnosis of the First Stages of Tuberculosis. Hans Steininger. Röntgenpraxis, Dec. 15, 1930, II, 1105.

Since Assmann and Redecker described the so-called infraclavicular infiltrate, cases have been described which showed a round, homogeneous shadow, especially in the infraclavicular region, as the first manifestation of a lung tuberculosis. The clinical findings are often uncertain and tubercle bacilli cannot always be demonstrated. It would be wrong to always call such infiltrations tuberculosis, as bronchopneumonias and grippe may produce the same picture. These difficulties are shown on repeated X-ray examinations.

The author concludes that it would be erroneous to diagnose a tuberculosis from such findings, in the face of uncertain clinical symptoms.

H. W. HEFKE, M.D.

The Significance of Advanced Tuberculous Infection of School Children. Eugene L. Opie. Jour. Am. Med. Assn., Oct. 18, 1930, XCV, 1151.

Within the past five years, extensive studies have demonstrated the widespread occurrence of grave tuberculous lesions in the lungs of children who do not seem to be sick, and, in many instances, are well nourished and appar-

ently in robust health. These children do not have the symptoms or physical signs usually associated with pulmonary tuberculosis. Tuberculous infection is discovered by the tuberculin test, and roentgenologic examination furnishes a measure of its severity by revealing the extent and character of the lesions. These studies have shown that the transition from latent to clinically manifest disease is often defined with much difficulty, and that some latent lesions are more extensive than those accompanied by symptoms and physical signs. A survey undertaken to discover tuberculosis in children of the public schools and the data from this are reviewed and discussed.

Routine roentgenologic methods are insufficient. Roentgenologic examination applied to the recognition of latent or clinically manifest lesions in children well enough to attend school requires methods specially adapted to examination of the chest, and the interpretation of films demands experience, together with intimate knowledge of the nature and clinical course of the disease. The application of roentgenologic methods to the examination of school children is costly.

In the search for tuberculous infection, two proceedings are available: (1) Examination by tuberculin tests and roentgenologic examination of all children known to be exposed to open tuberculosis; this method would be effective in proportion to the success of tuberculosis registration; (2) roentgenologic examination of school children who react to tuberculin, precedence being given to groups of children, such as adolescent girls and negro children, among whom the disease is known to be unusually frequent.

C. G. Sutherland, M.D.

Tuberculosis of the Intestine: Its Differential Diagnosis. J. Arnold Bargen. Minnesota Med., July, 1930, XIII, 457.

There are two main types of tuberculosis of the intestine, namely, the ulcerative and the hypertrophic. The hypertrophic types must be distinguished from malignancy, actinomycosis, and non-tuberculous pyogenic granuloma. The roentgenogram shows a filling defect, not unlike that of a malignant lesion, but usually larger. The ulcerative must be distinguished from chronic ulcerative colitis, amœbic ulceration, diverticulitis, polyposis, and malignant disease. The typical X-ray appearance is deformity in the cecum and ascending colon. There is not the immense thickening of the wall common in chronic colitis, and a tendency to persistence of haustra. Writhing and rapid filling and emptying of the ileocecal coil are seen under the fluoroscope. Amœbic ulceration may afford a real diagnostic difficulty, requiring other aids than X-ray for differentiation.

W. W. Watkins, M.D.

Suspected Juvenile Tuberculosis: Evaluation of Clinical Symptoms and Signs. Frederick Eberson, Jessie P. Delprat, and Ernst Wolff. Am. Jour. Dis. Child., October, 1930, XL, 753.

In a series of 306 children with suspected juvenile tuberculosis, the authors found that there was little or no difference between a group with positive and a group with negative tuberculin reactions, as judged by nine symptoms and ten clinical signs. The greatest difference between the two groups seemed to be in terms of nine roentgen observations that were studied. The roentgen observations listed in order of their occurrence, in cases with a positive tuberculin reaction, were: hilum calcifications, increased markings, enlarged bronchial lymph nodes, thickened interlobar pleura, peribronchial infiltration, calcified bronchial lymph nodes, primary focus, thickened apical pleura, and parenchymal tuberculosis.

The evidence presented showed that the commonly accepted clinical signs and symptoms have no diagnostic significance, except as they may be correlated with roentgenograms and tuberculin tests when these are definitely positive for tuberculosis. As a diagnostic criterion, roentgenograms in conjunction with tuberculin tests were unquestionably of value.

According to McPhedran, calcification of the lymph nodes can be recognized only as shadows having a granular appearance. The increase of perihilar shadows is due, not to

enlargement of bronchial nodes, but to pulsation and vibration of the arteries.

Roentgen observations presented the most favorable picture regarding differences between groups with positive reactions to tuberculin and those with negative reactions. However, in relation to the distribution of symptoms and clinical signs, in terms of the more important roentgen evidence, such differences did not exist.

F. B. MANDEVILLE, M.D.

The Roentgenologic Diagnosis of Tuberculosis of the Suprarenals. R. Schatzki. Röntgenpraxis, Dec. 15, 1930, II, 1130.

Eighty per cent of all cases of Addison's disease have tuberculosis as an etiologic basis. The roentgenologic demonstration of calcified foci of tuberculosis in the adrenals has, heretofore, been described but once, to the author's knowledge. A patient with Addison's disease, whom the author examined, presented definite and marked calcification in both adrenals, so marked that even the anatomical shape of the adrenals was apparent. Calcification may otherwise be shown only in tumors of the adrenals. A few such cases have been described.

H. W. HEFKE, M.D.

The Childhood Type of Tuberculosis. Eugene F. Johnson. Minnesota Med., September, 1930, XIII, 613.

Much is being written on the relation between adult and childhood tuberculosis. This paper presents some illustrative cases from the Nopeming Sanatorium. Childhood tuberculosis is the result of a primary infection with the tubercle bacillus and the initial lesion may be anywhere in the lung. Adult tuberculosis is the result of re-infection and the lesions are usually at the apices and along the pleura. The associated tracheobronchial lymph nodes are always involved in the childhood type, while in the adult they are not involved except in the terminal stages. Caseous lesions in the primary type become encapsulated or calcified, whereas, in the adult type they excavate or fibrose, or both. In the childhood type, infiltrative areas commonly resolve, with little evidence, while in the adult type infiltrated areas resolve, with production of fibrous tissue. These changes are shown by X-ray examination and must be borne in mind in interpreting X-ray densities.

W. W. WATKINS, M.D.

Hyperplastic Tuberculosis of the Duodenum and Terminal Ileum. John Day Garvin. Jour. Am. Med. Assn., Nov. 8, 1930, XCV, 1418.

Hyperplastic tuberculosis of the terminal lower ileum alone, without co-existent involvement of the cecum, is extremely rare. Involvement of the duodenum in the same process has hitherto never been reported. In the case cited here, previous roentgenographic, physical, and proctoscopic examinations were negative in their findings. In August, 1929, the barium flowing into the terminal ileum showed evidence of lack of spasticity or filling and emptying phenomena. To the palpating hand it presented a definite, infiltrated, thickened wall simulating a rope. One month later examination of the stomach gave evidence of obstruction and retention. At operation, tuberculosis of the terminal ileum and involvement of the duodenum with a similar type of lesion, were found. Resection could not be done and subsequent microscopic evidence was not obtained.

In the discussion Reynolds stated that he had found two cases of tuberculosis of the duodenum in the literature, one of which was proved at autopsy.

CHARLES G. SUTHERLAND, M.D.

The Early Roentgen Diagnosis of Pulmonary Tuberculosis. Leon J. Menville. New Orleans Med. and Surg. Jour., December, 1930, LXXXIII, 370.

When a pulmonary tuberculous lesion has reached such a size as to produce clinical symptoms, it is susceptible of being visualized on the X-ray film. The roentgen ray is the best single method at our disposal in the diagnosis of early pulmonary tuberculosis. Its accuracy is entirely dependent upon a good technic and a competent and experienced roentgenologist. A complete physical exam-

ination, with a careful history, should be obtained in every case suspected of pulmonary tuberculosis before being sent to the roentgenologist, and consultation should be the rule between the internist and the roentgenologist.

W. W. WATKINS, M.D.

TUBERCULOSIS (THERAPY)

Sun and Occupational Therapy for Surgical Tuberculosis Patients without Means. A. Rollier. Strahlentherapie, 1931, XXXIX, 213.

The author briefly describes in this article the international clinic shops which permit an occupation of the tuberculous patients during their stay in the Sanatorium. Even cases of spondylitis can do some work, as is illustrated in an accompanying picture showing a man lying in his bed on his stomach while using an electric drill placed near the head of the bed. This new development facilitates the return of the cured patients to the home and community as self-supporting citizens.

ERNST A. POHLE, M.D., Ph.D.

The Present Status and Importance of Deep Roentgen Therapy of Tuberculosis of the Lungs. H. Schulte-Tigges. Röntgenpraxis, Nov. 1, 1930, II, 983.

The animal experiments, clinical experience of others, technic, and indications for roentgen therapy of tuberculosis of the lungs are reviewed. Two hundred eighty-six patients have been treated during the last ten years, and the end-results seem very favorable and are much better than the results achieved by other sanatoria which do not use roentgen treatment. Careful selection of the patients, small doses of X-rays, and continued supervision of the patient are essential for a successful roentgen therapy.

H. W. HEFKE, M.D.

Phrenic Nerve Operations in Pulmonary Tuberculosis: Results in Five Hundred Cases. E. J. O'Brien. Jour. Am. Med. Assn., August 30, 1930, XCV, 650.

This is a review of the results in five hundred cases. Three hundred and seventy-eight were operated on for cavitation: in 50.5 per cent the cavities closed, and in 31.2 per cent they became smaller. Results proved more effective in moth-eaten cavities and in those with soft walls, especially the smaller ones. The best results were obtained with cavities at the base of the lung. In many instances the results of phrenicectomy were beyond expectations.

The combination of artificial pneumothorax and phrenicectomy was especially effective in accomplishing closure of cavities in the author's series.

In a series of tables, the results are tabulated in their different phases. Phrenicectomy is not an operation to be considered lightly. The results, however, are sufficient to warrant its more extensive use.

CHARLES G. SUTHERLAND, M.D.

The Limitations of Heliotherapy in Pulmonary Tuberculosis. Bernard Langdon Wyatt. Ann. Int. Med., October, 1930, IV, 376.

Heliotherapy, as defined by the writer, means the direct exposure of the surface of the body to the direct rays of the sun, although indirect effects will be produced by sky reflection and from air currents.

Patients with the so-called "surgical" forms of tuberculosis were not included in the series since the lung involvement is usually minimal, with a tendency to become quiescent rapidly. The number of patients showing appreciable improvement that might be attributed solely to direct heliotherapy was negligible.

The results derived from direct heliotherapy in pleural tuberculosis were most gratifying. Very satisfactory results were secured in tracheobronchial lymph-node involvement. The author believes that heliotherapy is of great value in preventing intrapulmonary extension from hilum tuberculosis, and quotes Mayer, of Saranac Lake, as follows: "When I think of extra-pulmonary tuberculosis I immediately think of light. On the other hand, when I think of pulmonary tuberculosis, I do not think of light. . . ."

C. H. DEWITT, M.D.

Tuberculous Spondylitis: Its Clinical Symptoms and Curative Results Following Sunlight and Fresh Air Treatment. Eugen Kisch and Hans Berger. Strahlentherapie, 1930, XXXIX, 109.

The authors report in this paper the results obtained in tuberculous spondylitis at the Tuberculosis Sanatorium of the City of Berlin. Of the 563 patients suffering from spondylitis which were seen during the past ten years, 94 (or 16.7 per cent) had paresis. In the majority of the cases, three or more vertebræ were diseased. Fifty-one of the patients (or 54.3 per cent) were cured clinically and roentgenographically. Twenty-three (24.5 per cent) were considerably improved and could be discharged; ten (10.6 per cent) had to be discharged unimproved mainly because of financial or social reasons; ten (10.6 per cent) died during the treatment. The average duration of treatment for the 51 cured cases was nineteen months.

ERNST A. POHLE, M.D., Ph.D.

TUMORS (DIAGNOSIS)

A Case of Perithelioma of Fascial Origin, with a Direct Antecedent History of Trauma. T. Valentine Cooper. Lancet, Dec. 6, 1930, CXIX, 1234.

The tumor in this case was interesting because of its unusual histological appearance and because of its close relationship to a previous injury. The patient was a woman, aged 58, who had been struck near the elbow-joint. A lump appeared immediately after the injury. She was able to use her arm, but as the lump enlarged to the size of a pear, and numbness and anesthesia over the distribution of the ulnar nerve appeared, with wasting of the innervated muscles, a piece of the mass was removed under general anesthesia for microscopic examination. A preliminary diagnosis of fibrosarcoma was made and the arm was amputated. From the section, the tumor apparently had its origin in the fascial intermuscular sheaths or septa. Microscopically, the section had the appearance of a tumor which has been classified as a perithelioma, in accordance with current teaching, although the author believes that on further investigation it seems probable that such a classification rests on very insecure and unscientific foundations. He suggests the name "perivascular sarcoma" for the tumor described, for this name gives a definite indication of the histological appearance, and does not produce confusion regarding the site and mode of origin.

H. J. ULLMANN, M.D.

Giant-celled Tumor of the Upper Jaw. H. W. Coates. Can. Med. Assn. Jour., May, 1930, XXII, 681.

This is a case report of a patient thirty-eight years of age. The tumor had been removed ten years previous to the date of this report. In size it was one and three-quarter inches by three-eighths of an inch. It was situated on the right upper alveolus and attached by a pedicle connected with the interior of the antrum through a perforation. The affected part of the superior maxilla was removed radically. The pathological report was giant-cell sarcoma.

At this date, ten years after the operation, the patient is well, and there is no evidence of the return of the growth.

L. J. CARTER, M.D.

The Diagnosis of Tumors Involving the Spinal Cord. Henry W. Woltman. Jour. Am. Med. Assn., Nov. 8, 1930, XCV, 1398.

This essay reviews the diagnosis, which is the phase of particular interest to medical men and which has, as its natural sequence, proper treatment. The patient's story is the most important step in the diagnosis. The earliest and commonest complaint is pain. The pain may be in the spine at the site of the tumor; it may be referred to the lower extremities even when the tumor lies high in the canal, but usually it is referred along the distribution of a posterior root, when it is known as a root pain. Root pains are segmentally distributed. The pain becomes more and more intense as tumors grow. Anything which suddenly increases the pressure of the spinal fluid aggravates the pain. Root pains have a habit of awakening the patient from sleep at 3 or 4 o'clock in the morning. Disturbances of

motility are evidenced in a slowly progressive weakness; the muscles become atrophied, weak and toneless, and their reflexes become correspondingly feeble. Disturbances of sensibility and sphincteric control add to the discomfort of the patient.

Roentgenography occasionally reveals erosion of bone produced by a tumor, or even a calcified tumor itself. It is also one of the most certain methods of excluding metastatic tumors and other diseases of bone. The introduction of an opaque medium, such as iodized oil, into the subarachnoid space through cisternal or lumbar puncture, usually does not help a difficult situation. Its use in differential diagnosis is limited and the preparations commonly used are somewhat irritating to the meninges. Differential diagnosis may be difficult. A discussion of the simulants follows. Repeated examinations may be necessary in order to establish a diagnosis. Exploration without definite indication of the correct level of disturbance is almost certain to result in disappointment.

CHARLES G. SUTHERLAND, M.D.

Changes in the Kidney Pelvis on the Roentgen Film Caused by Extra-renal Tumors. Robert Bachrach and Karl Hitzenberger. Röntgenpraxis, Nov. 1, 1930, II, 990.

Extra-renal tumors (liver, gall bladder, spleen) may change the shape of the kidney pelvis in a pyelogram by pressure in such a way that a differentiation of such a tumor from a renal neoplasm is not possible by means of a pyelogram. This fact is rarely mentioned in the literature. Eight case reports are given, with a reproduction of the deformities of the pelvis, in which four were caused by splenic tumors and four by the liver and gall bladder.

H. W. HEFKE, M.D.

Multiple Myeloma as a Single Lesion. Charles F. Geschickter. Ann. Surg., September, 1930, XCII, 425.

Geschickter and Copeland, in 1928, published a complete review of the literature on multiple myeloma, and added 13 case reports. The six cardinal diagnostic features of the disease are: (1) Multiple involvement of the skeletal trunk by tumor formation in an adult over 35 years of age; (2) pathologic fracture of a rib; (3) the presence of Bence-Jones bodies in the urine; (4) lumbar backache, with signs of early paraplegia; (5) an otherwise inexplicable anemia; (6) a chronic nephritis, with nitrogen retention and low blood pressure.

The author presents in detail a case of a white male, 45 years of age, who showed evidence of only a single bone lesion, diagnosed as myeloma. He cites another case in a man 37 years of age, in which later films showed progression to other bones.

A brief discussion limited to differential diagnosis from giant-cell tumor, Ewing's tumor, and metastatic carcinoma is given, and the author concludes that a primary bone destructive lesion occurring centrally in a single bone, in the shaft of an adult, without expansion of the bone shell, should always excite suspicion of malignancy. Rarely the lesion may be a latent bone cyst; most frequently it is a metastatic carcinoma, but occasionally a multiple myeloma. The entire skeleton and lungs should be examined by the X-ray, for in this way the multiple myeloma or metastatic bone tumor, both hopeless diseases, may be disclosed and an unnecessary operation avoided. The urine must be examined for Bence-Jones bodies.

F. B. MANDEVILLE, M.D.

Discussion of the Opaque Formations in the Abdomen, with Special Regard to Dermoid Cysts and Splenic Calcifications. Alessandro Vallebona. La Radiologia Medica, April, 1930, XVII, 365.

The author deals with the different shadows which may be observed in the abdomen, and discusses the difficulties offered by a diagnostic parallel. Special attention is given to the calcareous shadows which are apt to be overlooked by the radiologist, and to the differentiation of endocavitary deposits from calcic sediments in the tissues and from the shadows frequently observed in tumors and parasitic localizations. A comprehensive discus-

sion is given concerning various technics the radiologist may resort to in locating them, and regarding the difficulties encountered in determining their intrinsic nature, and the organ in which the calcifications are located.

The author gives a complete description of the images of phlebolites, and illustrates some observations on calcification of the lymphatic gland and the peritoneum. He reports two cases of dermoid cysts of the ovary and two cases of calcification of the spleen.

L. MARINELLI.

The Deposit of Active Bismuth in Malignant Tumors. Herbert Kahn. Strahlentherapie, 1930, XXXVII, 751.

The author presents a preliminary report of his experiments dealing with the effect of a bismuth preparation on human carcinoma when injected intramuscularly or intravenously. It was possible to deposit as much as 8 mgs. per cent without ill effects. A series of animal experiments supported the contention that tumor tissue deposits more bismuth than normal tissue. A combination of bismuth injections with irradiation seems also to be promising. The author, therefore, invites his colleagues to the further study of this therapeutic procedure.

ERNST A. POHLE, M.D., Ph.D.

Radiological Diagnosis and Radiation Therapy of Tumors of the Pituitary Body. Quintino Vischia. La Radiologia Medica, April, 1930, XVII, 409.

The author reports two cases of tumor of the hypophysis treated by roentgen rays. A detailed description is given of the symptomatology, the radiological aspect, and the prognosis of this disease. He is generally in favor of radiation therapy in almost all the stages of the growth, because he considers it the most safe and the one which is the most likely to yield satisfactory results. The author observed in one of the patients thus treated a partial reconstruction of the sella turcica, and accounts for this phenomenon on the grounds that X-rays stimulate, in the irradiated region, a cerebral zone which controls calcium metabolism. This would contradict the experimental findings of others who have noted a decrease in the calcium content of the blood after irradiation of the same zone.

The author concludes that in any case it is logical to assume the existence of a center, regulating calcium metabolism of the body.

L. MARINELLI.

A Case of Sarcoma Botryiodes Corporis Uteri. P. J. Kearns. Canadian Med. Assn. Jour., September, 1930, XXIII, 418.

This is a case report of a very rare condition, the first to be recorded in the Clinic of the Women's Pavilion of the Royal Victoria Hospital, Montreal. A tumor, associated with the uterus, was found on operation to be a firm, grape-like, nodular mass the size of a four months' pregnancy, growing from the top of the uterus. Pathologic examination showed a partly edematous, partly myxomatous, partly lymphangiectatic spindle-cell sarcoma.

L. J. CARTER, M.D.

Periosteal Lipoma: Report of Two Cases. Edwin I. Bartlett. Arch. Surg., December, 1930, XXI, 1015.

The author reports two soft tissue tumors which were sharply delimited, one lying in the soft tissues of the upper arm just above the elbow, and the other in the upper portion of the lower leg just below the knee. They were slightly lighter in density than the surrounding structures and had fan-like, radiating markings not bony in character. At operation these were found to be benign lipomas. They lay in immediate contact with the bone and were removed from it by sharp dissection. The periosteum below it was somewhat thickened, but the tumor came away intact.

HOWARD P. DOUB, M.D.

Lipoma of the Mediastinum. Wallace M. Yater and E. Stuart Lyddane. Am. Jour. Med. Sci., July, 1930, CLXXX, 79.

The authors review the literature on 11 cases of previously reported lipomata of the mediastinum, and add one more case of their own,

that of a male, aged 44, who entered the hospital with symptoms of lobar pneumonia. On autopsy a lipoma was revealed, arising from the anterior mediastinum and weighing 8¼ pounds. It displaced a large part of the right lung and extended over to the left side, partially covering the pericardium. Microscopic sections of the tumor showed that it was a pure lipoma. Lipomata may arise either from the mediastinum, the endothoracic fascia, or from the sub-peritoneal fat, forcing its way through the fibers of the diaphragm.

They conclude their article with a table including all the salient data of the 12 cases of lipoma of the mediastinum which have been reported.

ROE J. MAIER, M.D.

Hypernephroma with Virilism in a Child of Three Years. G. W. Harris and D. F. Plewes. Canadian Med. Assn. Jour., August, 1930, XXIII, 244.

Tumors of the suprarenal cortex accompanied by virilism are rare, only 24 cases having been reported prior to this one.

This case, reported from the Brantford Clinic, was one of left hypernephroma accompanied by virilism. The evidences of the latter were abundant pubic hair, deepened voice, and the development of the clitoris to a length of one and one-half inches.

The hypernephroma was successfully removed. Ten months later the secondary sexual characteristics were remaining stationary, while there was no sign of recurrence of the tumor.

L. J. CARTER, M.D.

Forcing the Demonstration of Canalization in Tumors of the Colon and Non-recognized Invagination of the Tumor. A. W. Fischer. Röntgenpraxis, Dec. 15, 1930, II, 1114.

In order to make a differential diagnosis between a benign and malignant tumor of the colon, one should not be satisfied to demonstrate only a filling defect or the Stierlin symptom, but should try to visualize the canalization itself. The shape of the tumor will assist in making a more definite diagnosis. It is often easy to show the canalization, but sometimes barium may be forced through only by inflation with air. The narrowing of the bowel lumen, so often explained by the tumor itself, is caused many times only by an invagination of a comparatively small tumor.

H. W. HEFKE, M.D.

Three Primary Malignant Epithelial Tumors of the Ano-rectal Region Occurring in One Person. D. M. Angevine. Canadian Med. Assn. Jour., July, 1930, XXIII, 38.

This is the first case recorded, so far as the author can determine, in which three primary malignant tumors were so closely related anatomically. The case came into the clinic of Dr. C. P. Howard in the Montreal General Hospital.

At autopsy a large squamous-cell carcinoma almost encircled the rectum just above the anal canal. In addition, there were two other firm areas at the mucocutaneous junction. One of these was an adenocarcinoma, while the other was a malignant tumor of the peri-anal mucous glands. Numerous metastases were found in the liver, lungs, lymph nodes, vertebræ, and ribs, and all were of the squamous-cell type.

L. J. CARTER, M.D.

Sarcoma of the Stomach: Report of Four Cases and Review of the Literature. Rigney D'Aunoy and Adelaide Zoeller. Am. Jour. Surg., September, 1930, IX, 444.

Sarcoma of the stomach comprises about 1 per cent of gastric malignancies. There are no pathognomonic features which give a preoperative diagnosis. This is accomplished by a histological examination of an excised portion of the tumor or of one of its metastases. Roentgenologically, these tumors are impossible of differentiation from carcinoma.

They tend to occur at an earlier average age than does carcinoma. The prognosis of gastric carcinoma would appear to be slightly better than that for carcinoma, as the former does not appear to metastasize so readily or so early. Three hundred and thirty-five cases of sarcoma of the stomach, including the four

reported in this article, are recorded in medicai literature for the year of 1929.

HOWARD P. DOUB, M.D.

TUMORS (THERAPY)

Multiple Myeloma: Report of Case. Lloyd Bryan and Joseph Levitin. California and Western Med., January, 1931, XXXIV, 15.

The authors report a case of multiple myeloma in which pain, the outstanding symptom in these conditions, was well controlled with X-ray therapy. This patient lived three and one-half years after the onset of the condition, which is nearly twice the average time. They discuss the clinical symptoms, laboratory findings, and differential diagnosis of multiple myeloma. The therapy used is only palliative, but in this case there was also a certain amount of new bone laid down, following the X-ray therapy. The article is illustrated with cuts of X-ray films and microscopic sections.

FRANCIS B. SHELDON, M.D.

The Reaction to Irradiation as a Means of Differentiating Certain Varieties of Tumor. Arthur U. Desjardins. Brit. Jour. Radiol., January, 1930, III, 6.

Every variety of cell in the body and every organ or structure made up wholly or largely of one variety of cell, has a specific sensitiveness to the X-ray or radium ray. The lymphocytes in the spleen, lymph nodes, intestinal lymph follicles, bronchial nodes, thymus gland, and circulating blood are most sensitive, next to which come the spermatogonial cells of the testis, and basal epithelium of the ovarian follicles. In certain types of tumors included in the groups classified as lymphoblastomas and embryonal carcinomas of the testis, the tumor response to irradiation may prove a more accurate criterion to diagnosis than a microscopic study of the small biopsy specimen, since the irradiation test involves the whole tumor, while the biopsy study may include only the less important element of the tumor. Lymphosarcomatous tumors may react even more rapidly than Hodgkin's disease or lymphatic leukemia, although in the average case the difference is scarcely recognizable.

The author calls attention to a group of tumors arising around the base of the tongue, tonsils, and nasopharynx which, microscopically, resemble epithelioma, but contain a considerable portion of lymphoid cells which are quite radiosensitive. These tumors have been called lympho-epitheliomas, a term which may be objectionable in the eyes of the pathologist, but serves to indicate their satisfactory response to therapeutic irradiation.

The only other tumor closely approaching the lymphoblastomas in irradiation response is the pure embryonal carcinoma of the testis. The mixed or teratoid tumors of the testis are much less responsive, and hence less effectively controlled.

The typical response of the benign giant-cell tumor to a moderate dose of rays is, at first, swelling, with redness and pain a few days after the exposure, but after about two weeks the swelling and redness disappear, and over a period of from six to twelve months the tumor area is usually replaced by dense bone.

Malignant tumors of bone are rarely very responsive to treatment, although usually Ewing's endothelial myeloma and the chondrosarcoma will show a prompt initial response to irradiation.

J. E. HABBE, M.D.

Tumors of the Parotid Gland. Edward B. Benedict and Joe V. Meigs. Surg., Gynec. and Obst., November, 1930, LI, 626.

This is a report based upon the study of 225 cases of parotid gland tumor from the records of the Massachusetts General and the Collis P. Huntington Memorial Hospitals. The etiology, pathology, occurrence, signs and symptoms are discussed. Under the heading "treatment," the following statement is given: "The treatment in practically all cases should be operative. Radium or X-ray treatment in our experience has been only palliative, never curative. Moreover, without operation, no pathological report is obtained, so that, not

knowing with what type of tumor we are dealing, the treatment may be unsatisfactory, and no conclusions can be drawn from it. In a very large malignant tumor, in which there is no hope of cure, radium or X-ray may be used—chiefly valuable in recurrent malignant tumors. We are aware that some surgeons may have a higher regard for radiation treatment than we have, but certainly in this relatively large series of carefully followed cases, there is no evidence for attributing the permanent cure of a single parotid tumor to the use of X-ray or radium."

The authors summarize as follows:

1. Benign tumors are more common than malignant tumors in the ratio of about four to three.

2. Carcinoma is about twice as common as sarcoma.

3. Cysts, melanotic sarcomata, and adenomata are extremely rare.

4. Mixed tumors are essentially benign, but recur locally with great frequency. They rarely become malignant.

5. Malignant parotid tumors are very difficult to cure, and early radical operation is advised.

6. Patients with mixed tumors live indefinitely, while those with malignant disease rarely live over two years after operation.

7. Radium and X-ray are useful in the treatment of malignant parotid tumors, but only as palliative procedures. In the treatment of benign parotid tumors, radiation therapy is of benefit in some cases, but we believe excision is the treatment of choice.

8. Carcinoma, sarcoma, and malignant lymphoma may invade the parotid gland secondarily. Such cases usually end fatally, but one brilliant cure reported here justifies many extensive operations and emphasizes the importance of not giving up in our struggle against malignant disease.

D. S. CHILDS, M.D.

Intrathoracic, Extra-pleural Granulation Tumors. Otto Dyes. Fortschr. a. d. Geb. d. Röntgenstr., July, 1930, XLII, 45.

The paper contains a discussion of attempts at roentgenologic differentiation of pathology of the thoracic cage, the pleura and peripheral pulmonary areas. For interpretation of marginal chest shadows, when tuberculosis, actinomycosis of thoracic cage, pleura or peripheral lung areas, pleural endothelioma, carcinoma, sarcoma—primary, as fibrochondromyxoneuro-sarcomata, or the more frequent metastatic—encapsulated pleural effusion, or lipoma have to be differentiated, considerable information may be obtained. However, especially in the cases of large tumor masses, often one cannot arrive at an etiological diagnosis.

The paper is illustrated by a few cases of tuberculous granulomata, forming dumb-bell shaped masses, partly in epicostal, partly in subcostal but extra-pleural location, and arising from small areas of caries in the ribs. It is stated that radiation treatment in doubtful cases may be used as a diagnostic aid, since tuberculous granulations are usually quite responsive to medium doses of roentgen therapy, while, for instance, actinomycosis requires much more intense irradiation.

HANS A. JARRE, M.D.

A Few Cases of Sarcoma of the Uterus Treated by Irradiation. Cl. Regaud and A. Lacassagne. Strahlentherapie, 1930, XXXVII, 275.

The *rationale* of the treatment of uterine sarcoma is a much discussed problem. In this article the histories of six cases are fully related, accompanied by microphotograms of the different types of tumors. One case was treated in 1920 with radium alone. Since the methods used at that time are not comparable with the modern procedure, they cannot be used in the compilation of results. In only two cases could the complete irradiation (radium internally and X-rays externally) be carried out. In the three remaining women, the systemic reaction due to rapid tumor tissue destruction prevented further treatment. One completely treated patient is still free from symptoms three and one-half years later; in all the others, death occurred within six months following the beginning of the treatment. In operable cases, therefore, surgery

should be combined with pre-operative irradiation. Caution is indicated in inoperable tumors because of the possibility of aggravating the condition of the patient, due to infection resulting from the necrosis of the tumor.

ERNST A. POHLE, M.D., Ph.D.

The Management of Giant-cell Sarcoma of the Vertebræ: Report of a Case with Cure after Five Years. John O. Bower, Jefferson H. Clark, and Leon Davis. Arch. Surg., August, 1930, XXI, 313.

From the experience of the authors, they believe that giant-cell tumors of the vertebræ should not be considered benign, as compared with giant-cell tumors of the bone elsewhere. These tumors possess the tendency to metastasize rarely, to recur commonly, and to produce cachexia invariably. Operation is a very difficult procedure in the vertebræ, and in over one-half of the cases there were local recurrences.

The authors believe that the best treatment for this type of tumor is the insertion of radium into or near the growth, with as little trauma as possible. Giant cells are peculiarly susceptible to radium rays.

HOWARD P. DOUB, M.D.

Irradiation Therapy of Malignant Tumors in Sweden. Gösta Forssell. Wien. klin. Wchnschr., Sept. 18, 1930, XLIII, 1161, and Sept. 25, 1930, XLIII, 1194.

The conditions at the Radiumhemmet gave an excellent opportunity to draw conclusions about the irradiation therapy of malignant tumors. Not only could inoperable patients be treated with X-rays and radium, but a great many borderline cases and operable cases, as well, were treated by means of radiotherapy only. The follow-up of the patients could be so perfected that the statistics, since 1910, are almost complete. Irradiation therapy alone led to a five-year cure in skin carcinomas in 69 per cent of all cases, and in 78 per cent in operable cases. Surgical end-results, taken from a large group of Swedish statistics, show a five-year cure in 65 per cent in the operable group. In carcinoma of the lip, radiotherapy reached 68 per cent of five-year cures, and surgery 62 per cent. Included in the irradiated group, however, were 20 per cent of inoperable cases. Carcinomas of the oral cavity, of which 75 per cent were inoperable, showed 18 per cent of five-year cures when treated by radium and X-rays. Surgery was responsible for 41 per cent of five-year cures in carcinoma of the tongue with metastases, while irradiation brought the percentage up to 60. Carcinomas of the cervix uteri, of which 75 per cent were inoperable or borderline cases, showed a five-year cure in 26.6 per cent with irradiation, 18 per cent with surgery. If one considers operable and borderline cases only, the percentage is 40.4 by irradiation and 35.6 by survery. Carcinoma of the corpus uteri showed about the same results (43 per cent) by either means of treatment. Twenty-four per cent of all primary sarcomas could be cured for five years, the greatest number of all cases being inoperable; 18 per cent of recurrences after operation could still be cured.

These results permit of the conclusion that irradiation therapy in these tumors stands very well compared with surgery alone. For carcinoma of the skin, lip, and uterus, irradiation therapy should be considered the method of choice, sometimes in combination with surgery. Good results by X-ray and radium can be achieved in other tumors also, as carcinoma of the thyroid, vulva, ovaries, and breast, but only inoperable cases have been treated and statistics are not available as yet. A combination of surgery or electrocoagulation with irradiation has been used more and more during the last ten years. Such a combination has led to 77 per cent of three-year cures in carcinoma of the lip, 75 per cent of three-year cures in carcinoma of the tongue, and 80 per cent in oral carcinoma without metastases. For carcinoma of the breast, pre- and post-operative irradiation is the method of choice. Combined surgery and irradiation prolongs the life of such patients longer than surgery alone, and local recurrences in the irradiated fields are comparatively infrequent. Radiotherapy in combination with surgery ought to be the

method of choice in carcinomas of the mouth, the maxilla, the breast, the pharynx, the thyroid, the ovaries, and the external female genitalia. In borderline cases of carcinomas of the pharynx and thyroid, irradiation alone should be employed. In 40 per cent of all cases of carcinoma, irradiation therapy either with or without surgery is indicated; the other 60 per cent, however, belong to the surgeon alone, including all carcinomas of the digestive tract. Of 4,470 carcinoma patients from 1921 to 1927, 38 per cent were symptom-free for shorter or longer periods; 24 per cent of all sarcomas could be made symptom-free. The palliation produced by radiant energy should not be minimized, and the above results give some indication of such action.

Only well equipped centers are able to develop irradiation therapy to such an extent that it may compete with surgery. Co-operation between the surgeon and the radiologist is essential to good results. Radium and X-rays alone cannot cure a carcinoma—able and well trained physicians must administer them.

H. W. HEFKE, M.D.

Three Cases of Neuroma: Cirsoid Neuroma of Face; Neurofibroma of Stomach; Posterior Tibial Neurofibroma. James T. Case. Am. Jour. Surg., March, 1930, VIII, 648.

Three cases of nerve tumors of the neurofibroma type are described.

The first case was an extensive cirsoid neurofibroma of the head and face, with roentgen evidence of bone changes in the frontal and parietal area, and distortion of the facial bones. This was treated by combined surgical and roentgen therapy and the patient has remained well for fifteen years. Inasmuch as this had previously recurred following surgical treatment alone, it is suggested that radiation therapy should be applied to these cases either alone, or as a supplement to surgical intervention.

The second case was a large neurofibroma of the posterior wall of the stomach near the pylorus.

The third case was a neurofibroma of the posterior tibial nerve. This can be seen on a plain roentgenogram as a soft-tissue shadow.

H. P. DOUB, M.D.

ULTRA-VIOLET LIGHT

The Use of Ultra-violet Light (Osram-Vitalux-Lamp) in Diseases of the Respiratory System. A. Moeller. Med. Klin., June 13, 1930, XXVI, 887.

During his studies of the influence of ultra-violet radiation on diseases of the respiratory system the author found that beginning colds frequently may be checked, especially with radiation through the open mouth. Light therapy in pulmonary tuberculosis should be handled very carefully. All cases of active tuberculosis, especially of the exudative type, should be excluded from any light therapy. An elevated temperature and hemoptysis are contra-indications also. In chronic cirrhotic types and in the productive type one can use light therapy with success. The treatment should be done very carefully and the dose should be varied according to individual indication. One must realize that the action of the ultra-violet rays on the lung tissue must be an indirect one. Treatment of bronchial and cardiac asthma has not been successful. In tuberculosis of the hilum glands one may notice a distinct decrease in size only after irradiation for several months.

H. W. HEFKE, M.D.

The Dosage of Ultra-violet Radiation in Infants with Tetany. Harry Bakwin and Ruth Morris Bakwin. Jour. Am. Med. Assn., Aug. 9, 1930, XCV, 396.

There is a widespread impression that, if excessive skin irritation is avoided, the greater the amount of ultra-violet radiation given, the better. Numerous observations indicate that the effect is not proportional to the dosage and that an effect produced by a smaller dose may be reversed when a larger dose is given. When cholesterol or ergosterol is irradiated, the antirachitic potency rises for a time and then falls as the irradiation is continued.

The effect of measured amounts of ultra-violet radiant energy on the serum calcium of

twenty-eight infants with tetany was studied. The intensity of radiant energy was measured by the oxalic acid-uranyl sulphate method of Anderson and Robinson.

In the use of ultra-violet radiation for infants with tetany, there is an optimal range of dosage above and below which the rate of rise in the serum calcium is slowed. A daily dosage of two minutes front and two minutes back at 50 cm. is optimal unless the burner is badly deteriorated.

When large enough doses of ultra-violet radiation are used, the average daily rate of rise in the serum calcium of white and of Negro infants with tetany is about the same, but the minimal dosage necessary for cure is greater in Negro than in white infants.

CHARLES G. SUTHERLAND, M.D.

On the Ultra-violet of the Sun. Ch. Fabry and H. Buisson. Strahlentherapie, 1930, XXXVI, 410.

The Intensities of the Short Ultra-violet Rays in the Sun Spectrum. F. W. Paul Götz. Strahlentherapie, 1930, XXXVI, 429.

The paper by Fabry and Buisson presents data on the amount of radiation emitted by the sun as compared with the amount reaching the earth. It concludes with a graphic presentation of the composition of the ultra-violet in the sun spectrum after passing through the atmosphere.

Götz offers the results of measurements carried out in Arosa on a clear summer day, and compares the erythema effect of the ultra-violet in the sun before and after filtration through the atmosphere.

ERNST A. POHLE, M.D., Ph.D.

Osteitis Deformans: Its Treatment by Ultra-violet Rays. Clement Nicory. Brit. Med. Jour., March 15, 1930, No. 3610, p. 492.

Case histories are given of four patients with osteitis deformans treated by irradiation with ultra-violet light, using a mercury vapor lamp. Over a period of three years these cases have shown a complete disappearance of symptoms, with a marked return of the bones to normality. Comparative X-ray films are reproduced.

The author publishes these cases with a view to getting a greater number of patients treated by this method, and having his findings confirmed or otherwise.

WALLACE D. MACKENZIE, M.D.

Ultra-violet Light in the Treatment of the Dull and Backward Child. Frank Sugden. British Med. Jour., Nov. 29, 1930, No. 3647, p. 905.

The author has had considerable experience in the institutional treatment of dull and backward children, and has been impressed by the improvement in the standard of mentality of many of the cases under treatment by actinotherapy. He suggests that as there is no definite line of demarcation between the dull and backward and the mentally deficient type, it is reasonable to assume that patients may be selected and their standard of mentality be considerably raised by actinotherapy. The same standard of improvement cannot be expected to obtain in every case, but, with the exception of those children who turn out to be of definite mental deficiency, it is very exceptional to find one who will not show signs of both physical and mental development.

WALLACE MACKENZIE, M.D.

On a Case of Similar Effect of Ultra-violet and of Roentgen Rays. K. Brummer. Strahlentherapie, 1930, XXXVI, 716.

In white rats weighing from 40 to 60 grams, rickets was produced by omitting vitamines from their food. After three weeks, roentgenograms were taken as a control, and a part of the animals was then treated with ergosterol which had been activated by roentgen rays of long wave length. The ergosterol had been irradiated in powder form by roentgen rays produced at 7 K.V., 10 ma., 3 cm. F.D., for 60 seconds and also for 60 minutes. Each rat received 0.0006 mgs. ergosterol per day. The control rats were kept on the same amount of unirradiated ergosterol. The rats which had received the irradiated ergosterol for three weeks did not show any signs of

rickets and had gained from 20 to 30 grams. The control animals showed severe symptoms of rickets and two had died before the end of three weeks.

The author concludes from these experiments that roentgen rays of long wave length can also activate ergosterol.

ERNST A. POHLE, M.D., Ph.D.

Symposium on Ultra-violet Therapy. Med. Jour. and Record, Dec. 17, 1930, CXXXII, 591.

This is a series of articles on various aspects of ultra-violet therapy, as follows: "Different Methods of Applying Ultra-violet Radiation," by W. Kerr Russell, of London, England; "Biological Studies of Sunlight Filters," by Walter H. Eddy, of New York; "The Status of Window Materials for Transmitting Ultra-violet Radiation," by W. W. Coblentz, of Washington, D. C.; "The Measurement of Therapeutic Ultra-violet," by Roger S. Estey, of New York; "The Tungsten Arc as a Source of Ultra-violet Radiation," by W. J. Turrell, of Oxford, England; "The Decrease in Ultra-violet and Total Radiation with Usage of Quartz Mercury Arc Lamps," by William T. Anderson, Jr., of Newark, N. J.; "Sunshine for Therapeutic Use," by M. J. Dorcas, of Cleveland, Ohio.

The series of papers constitutes a good review of the technical and physical phases of ultra-violet radiation, and are recorded here, without abstracting, for the information of those who may be looking for such references.

W. W. WATKINS, M.D.

The Effect of Ultra-violet Radiation on Tissue Cultures. Edmund Mayer. Strahlentherapie, 1930, XXXIX, 148.

In this paper, the results of extensive experiments concerning the effect of visible light or ultra-violet light alone, and of a combination of both—of an ultra-violet line or a continuous spectrum—on fibroblast cultures are reported. A quartz mercury vapor lamp and a Vitalux lamp served as sources of radiation. It appears that visible light alone inhibits the growth and that ultra-violet light alone inhibits it more or less. For the effectiveness of ultra-violet light, the presence of visible light is quantitatively without any influence. The continuous ultra-violet spectrum produces the same effect as an ultra-violet line spectrum. The various degrees of inhibition of growth can be brought about by varying the exposure time and by any combination of ultra-violet rays. It seems, therefore, that the inhibition of growth in tissue cultures may be used as a biologic measurement method for ultra-violet radiation. Numerous graphs and a few photomicrograms illustrate the article.

ERNST A. POHLE, M.D., Ph.D.

The Effect of the Visible Light, the Infra-red, and Ultra-violet Rays on the Eye. Wolfgang Hoffmann. Strahlentherapie, 1930, XXXIX, 93.

This is a brief review of our present knowledge concerning the effect of light rays on the various parts of the eye. It is stated that the so-called "glass-blower's cataract" is in all probability caused by infra-red rays, although no definite experimental proof has been furnished for this assumption.

ERNST A. POHLE, M.D., Ph.D.

Erythema Tests with the Vitalux Lamp. Stephan Epstein. Strahlentherapie, 1930, XXXVIII, 372.

In view of the discrepancies in literature concerning the erythema effect of the Vitalux lamp, the author exposed a number of patients to this light under various conditions. He found that a true ultra-violet erythema could be produced in four out of seven cases following an exposure of two hours, at 90 to 100 cm. distance, over an area of 3 cm. × 4 cm.

ERNST A. POHLE, M.D., Ph.D.

Cutaneous Papillomata in the Rat Following Exposure to Ultra-violet Light. G. M. Findlay. Lancet, June 7, 1930, CCXVIII, 1229.

Although much attention has been paid to chronic irritation by many substances in the production of cancer, little attention has

been paid to the possibility of carcinogenic action by ultra-violet rays, although there is abundant clinical evidence to suggest that prolonged exposure to sunlight rich in ultra-violet is a cause of skin cancer in man. In Australia, where there is a Northern European population exposed to prolonged and intense sunlight, rodent ulcer and epithelioma of the skin are far commoner than in Great Britain, and, in addition, white cattle in Australia are especially liable to develop epitheliomata, so much so that in Queensland farmers have now abandoned the breeding of white cattle, owing to their liability to develop cancer of the skin. This parallelism of extreme liability to skin cancer in poorly pigmented persons and animals is very striking, and strongly suggests that chronic dermatitis, due to excessive exposure to sunlight rich in ultra-violet, plays a not unimportant part in the etiology of skin cancer both in man and in cattle.

In a previous communication (1928) the author brought forward evidence to show that exposure to the mercury vapor lamp is capable of exciting carcinomatous changes in the skin of a mouse, if these are continued over a period of at least eight months. He now reports similar experiments on albino rats. Six of these animals were used, about six months old, and, after epilations with sodium sulphide, were exposed to the light of a mercury vapor lamp three times a week. Three of these rats were alive eighteen months later and apparently in normal health (nothing is said as to the cause of death of the other three). One month later the author referred to one of the two surviving rats, so that a fourth must have died in that period. At twenty months, a small papilloma was noticed on the dorsal surface of the right ear of this animal, which had, at nineteen months, developed a white opacity in the cornea of the right eye. This papilloma of the ear grew rapidly into a large, horny excrescence. A month later two small ones appeared on the dorsal surface of the left ear. At this period the rat died of bronchopneumonia. Microscopically, the tumor of the right ear had all the appearance of a rapidly growing papilloma, with cell-nest formation and much keratinization; cartilage of the ear was intact. There was no infiltration or metastases, but the author believes that such a rapid growth suggests that infiltration would have occurred had the animal lived longer, and it should also be noted that the growth continued in the absence of further exposures to the lamp. Microscopic study of the eye may have been a sarcomatous condition of the conjunctiva, but it is believed that it was more probably a chronic inflammatory lesion.

H. J. Ullmann, M.D.

Further Studies on the Biological Action of Radiations of Different Wave Lengths. Ettore Conte. La Radiologia Medica, June, 1930, XVII, 689.

The results of these experimental researches seem to contradict the findings of Ludwig and von Ries, who believe in an antagonistic action between ultra-violet and infra-red rays They may be summarized as follows:

(*a*) The biological action of ultra-violet rays on experimental rickets of white mice cannot be prevented or retarded by infra-red radiation.

(*b*) This fact is verified when the radiating energy is administered for either therapeutic or preventive purposes.

(*c*) Infra-red rays alone may accelerate, within certain limits, the manifestations of rickets in mice fed with Steenbock's diet.

L. Marinelli.

The Principles of a new Ultra-violet Dosimeter. Edith Weyde. Strahlentherapie, 1930, XXXVIII, 378.

An instrument is described for the measuring of the erythema producing part of the ultra-violet spectrum, making use of a light-sensitive solution. When exposed to ultra-violet light, the solution changes to a blue color and discolors again in the dark. It can, therefore, be used for several hundreds of tests. The degree of bluing is determined by a colorimeter whose scale is calibrated in terms of skin erythema. Investigations proved

that the so-called "I × T law" (Intensity × Time) does not hold in this case. It is necessary to add a correction factor which was found to be 0.7 in twelve examined persons. The relation has to be changed, therefore, to $I \times T^{0.7}$. The error of measurement amounts to plus or minus 20 per cent.

ERNST A. POHLE, M.D., Ph.D.

Sources of Radiation and Their Physical Characteristics. W. W. Coblentz. Jour. Am. Med. Assn., August 9, 1930, XCV, 411.

This supplements a previous paper (June 1, 1929), with data on sources of ultra-violet and infra-red radiation. There seems to be sufficient biologic evidence to show that the effect of ultra-violet radiation is photochemical, and that there is a minimum or threshold value below which this action is ineffective, especially as regards the physiologic action obtained in an exposure of reasonable length.

The tungsten filament lamp, even when enclosed in a bulb that transmits the ultra-violet rays of wave lengths from 280 to 310 millimicrons, emits but little ultra-violet rays of these wave lengths.

The ultra-violet spectrum of the mercury arc consists of a series of intense emission lines irregularly distributed throughout the ultra-violet and visible spectrum.

The incandescent tungsten filament produces a continuous emission spectrum having a high intensity throughout the visible into the infra-red.

A recent production is a combination of a mercury arc between highly incandescent electrodes of tungsten. A tungsten filament operates in parallel with the mercury arc, but it is at a considerably lower temperature than the incandescent tungsten electrodes. The surrounding globe, of special glass, absorbs the rays of wave lengths less than 280 millimicrons not present in sunlight. The mercury arc supplements the ultra-violet radiation at from 280 to 365 millimicrons, which is only feebly emitted by the incandescent tungsten electrodes.

The result of this combination of incandescent solid and arc-vapor radiation is an unusual emission spectrum, consisting of a series of strong ultra-violet emission lines of mercury vapor superimposed on a continuous spectrum radiation from the incandescent solid, which increases rapidly in intensity and extends throughout the visible and into the deep infra-red.

No data were obtained in the effect of aging of the lamp.

By means of a sensitive sodium in quartz bulb photo-electric cell it was found impossible to measure the ultra-violet rays from a radiant gas heater after provision was made that the burner be over-rated in order that measurements might be procured in normal operation, and also when an excess amount of gas was used. An attempt was made to measure the ultra-violet radiation emitted by the gas flame. Instead of attempting to use the radiant gas heater as an ultra-violet radiator, it should be obvious that such a radiant gas heater is an excellent source of intense infra-red radiation.

Various radiant heaters used for therapeutic purposes do not differ in principle from those used for heating dwellings.

CHARLES G. SUTHERLAND, M.D.

The Biologic Test of the Ultra-violet Radiation Emitted by a Vitalux Lamp. Lothar Böhmer. Strahlentherapie, 1930, XXXVI, 805.

The Vitalux lamp is constructed like an ordinary incandescent lamp but its bulb is made of ultra-violet transmitting glass. Since some investigators have questioned the ultra-violet emission of this lamp in the region around 3,000 Å., the author exposed fields on the chest and abdomen of patients, at 80 cm. distance, for 90 minutes. In each case, half of the area was covered by glass which did not transmit below 3,300 Å. After 20 hours, a definite erythema appeared on the uncovered area. A photograph of the reaction and also a spectrogram of the Vitalux lamp, unfiltered and filtered through the glass, are appended. The conclusion arrived at is that there is sufficient radiant energy below 3,300 Å. in the emission of the Vitalux lamp to produce an erythema.

ERNST A. POHLE, M.D., Ph.D.

The Irradiation of Body Cavities by Ultra-violet Light Generated in Them. Stephan Westmann. Med. Klinik, Aug. 1, 1930, XXVI, 1146.

The author describes some instruments designed to bring direct ultra-violet radiation into body cavities. For treatment of laryngeal lesions an endoscope has been devised, with a quartz window on its tip and the mechanism which produces the ultra-violet rays in the endoscope itself. A cystoscope has been constructed similarly. Electrical accidents are avoided by insulation. Spectral analysis shows emission of ultra-violet rays in sufficient amounts to cause a definite reaction. Exposure of limited areas in body cavities is possible with these devices, and may lead to therapeutic results.

H. W. Hefke, M.D.

On the Time Factor of the Reaction of Albumin to Radiation. Wolfgang Gentner and Kurt Schwerin. Strahlentherapie, 1930, XXXVII, 788.

The authors continue their experiments concerning the effect of radiation on albumins. In this paper, they report the results of the effect of different intensities of ultra-violet rays on albumin solutions. The latter were exposed in a quartz tube which had been placed in front of the chamber of a dosimeter. The authors found that the time factor is almost equal to one and that only with very high intensities of the radiation employed is there a definite difference in the reaction.

Ernst A. Pohle, M.D., Ph.D.

WOUNDS (THERAPY)

The Healing of Operative Wounds in Irradiated Tissues. Vittorio Podestà. Rivista di Radiologia e Fisica Medica, August, 1930, II, 446.

The author reports some experiments on rabbits on the healing of wounds, and concludes that large doses of radium delay the process of cicatrization, and if the doses are very large there is no healing whatever. These doses produce a necrosis of the deeper tissues in direct contact with the radium which does not permit healing to take place until the necrotic tissue has sloughed, and the superficial tissues at the same time show little tendency to close in. As a corollary, the author is of the opinion that in radiosurgery it is best to treat the wounds as lacerated-contused wounds, with great traumatism to the tissues, to wait for sloughing and localization of the process, and then to make a wide excision, followed by suture, through healthy tissue.

The article is supplemented by many photomicrographs and a bibliography.

E. T. Leddy, M.D.

The Rate of Healing of Electrosurgical Wounds as Expressed by Tensile Strength. John D. Ellis. Jour. Am. Med. Assn., Jan. 3, 1931, XCVI, 16.

For the purpose of description of the histologic effects of high frequency cutting currents on tissues, the relative and roughly descriptive terms of cutting, desiccation, and coagulation can be accepted. The use of cutting currents, with just enough desiccation to control capillary hemorrhage without resulting in coagulation and slough, has made justifiable many surgical operations in easily bleeding fields that would formerly have been considered foolhardy. Examples of this are the revolutionizing of brain surgery, partial hepatectomy, and splenectomy for laceration; widespread excisions of facial cancers without subsequent slough, and operations on the jaundiced patient, who is prone to bleed freely from the incisions. The enthusiasm for the new surgical currents has led to some quite optimistic reports regarding uniformly primary healing and rapid cicatrization of electrosurgical incisions.

A study of the tensile strength per centimeter of length, at various time intervals, of healing incisions of skin, muscle, and stomach were performed in dogs. Control scalpel wounds were made. Only 60 per cent of the

electrically produced skin wounds showed primary union in comparison with 97.5 per cent of primary union in the control scalpel wounds, which indicates the futility of expecting primary skin healing in a fair percentage of electrical wounds. When union did occur, the wound was somewhat weaker than in corresponding scalpel wounds, and in the case of heavy dehydration did not attain a strength equal to the scalpel wound in twenty-one days. The stomach and muscle incisions electrically produced show the same percentage of primary union as the scalpel wounds. The electrically produced stomach wounds are notably weaker at about the mid-point of healing. The electrically produced muscle wounds are of almost equal strength with the scalpel wounds through the entire healing period.

While these observations do not argue against the employment of the electrosurgical knife for making surgical incisions when clear-cut indications for its use present themselves, this method cannot be considered as a practical substitute for the scalpel for routine use.

CHARLES G. SUTHERLAND, M.D.

Studies on the Prophylactic Effect of Irradiation on Inflammations.

On the Influence of Roentgen Rays on the Healing of Wounds. Shuichi Fukase. Strahlentherapie, 1930, XXXVI, 95 and 102.

The author studied the effect of roentgen rays upon the healing of skin wounds in rabbits. Two types of radiation were used, 170 K.V., filtered through 3.0 mm. Al or through 0.5 mm. Zn. The dose in both cases amounted to 400 r. It appeared that the heavily filtered irradiation was more effective. The wounds healed much quicker than the untreated parts; there is a true inhibitory action of roentgen rays on the inflammatory reaction in tissue.

ERNST A. POHLE, M.D., Ph.D.